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VIEWS, NEWS AND INTERVIEWS.

Citizens of the United States may now obtain patents in Japan, says the *Scientific American*. Japan has been very active in adopting American and European inventions; and as patents heretofore have been granted only for inventions made by native Japanese, the foreign inventor could not obtain protection, foreign inventions becoming public property as soon as publication had taken place. Foreigners may now obtain Japanese patents, provided the application is filed before the invention becomes publicly known or used in Japan. The population of Japan is estimated at about 40,000,000.

Hon. John T. Crisp has introduced into the Missouri House of Representatives a bill providing that telegraph companies in Missouri shall charge 15 cents for the first 10 words in a message and one cent for each additional word.

According to a Newark, N. J., paper, a bookkeeper for a manufacturing firm over the railroad has a friend uptown who is a notary public, and who has taken his affidavit on several occasions. He called him the other day on the telephone and explained that he wanted an affidavit taken, but was too busy to leave his office. "If I sign the form—and you knowing signature—will you put your seal to the affidavit?" asked the bookkeeper.

"Certainly," answered the notary. "Take your hat off and raise your hand; have you done so?"

"Hat's off; hand's up," came the response over the 'phone.

"Do you solemnly swear the accounts are correct, etc.?" asked the notary. "Send up the paper and I'll stamp it."

The affidavit will probably never be questioned, but it is clearly illegal.

The United States Electric Lighting Company, of New York, has filed a bill in equity against Vallee Brothers & Company, of Philadelphia, alleging that the defendants are using and selling, without license from the plaintiff, certain electric lamps, the exclusive right to which is claimed by the plaintiff under a patent right. The court is asked to restrain the defendants from the making of the alleged infringement.

The entire system of street railways at Galveston, Tex., is tied up by a strike of the employés. The company recently announced that the pay of extra conductors would be reduced from 15 to 14 cents an hour, and their time would be shortened. This was not satisfactory to the employés, and they protested. The company remained firm and the men struck. A committee of citizens waited on both the employés and the company, but failed to bring about an adjustment.

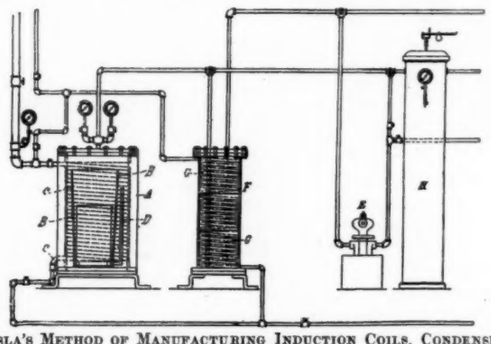
It is reported from Washington that the House has reduced the appropriation for street-car mail service $100,000, and limited the price to be paid per mile to the present rate. The matter is now in the hands of the Senate. This reduction, if concurred in by the Senate, would work a grave injury to this service, and would greatly reduce the efficiency of the system in vogue in Boston and elsewhere.

Receiver W. W. Fagan, of the Consolidated Electric Light and Power Company, of Kansas City, Kas., has made an order discharging all the old employés of the plant, except lamp-trimmers, and employed union men in their stead.

Tesla's Improved Condensers and Induction Coils.

Ever since Mr. Tesla discovered the hurtful action of the air and gaseous matter in induction coils and condensers, he has applied himself to perfecting his apparatus and methods with the view of overcoming the fatal defects produced by these causes. As an evidence of his progress in this direction, the ELECTRICAL REVIEW publishes herewith an abstract of a patent granted to Mr. Tesla on February 23, 1897, which was filed in the United States Patent Office on November 5, 1896. In his specification Mr. Tesla says:

My invention is an improvement in



TESLA'S METHOD OF MANUFACTURING INDUCTION COILS, CONDENSERS AND SIMILAR DEVICES.

the manufacture of electrical condensers, coils and other devices of a similar character, in which conductors designed to form paths for currents of high potential are brought into close proximity with each other. Among such devices are included many forms of condensers, transformers, self-induction coils, rheostats and the like.

It has heretofore been shown by me that the efficiency and practicability of such devices are very greatly enhanced by the exclusion of air or gas from the dielectric separating the conductors or remote portions of the same conductor, and the object of my present improvement is to secure such exclusion of air in as perfect a manner as possible in a convenient and practicable way. To this end I place the condenser, or other device to be treated, in a receptacle, from which the air may be more or less perfectly exhausted, and while in vacuum I introduce an insulating substance, which liquefies when subjected to heat, such as paraffine, which surrounds the said device and finds its way into its interstices.

When the device has become thoroughly saturated with the insulating material, it is allowed to cool off usually until the material begins to solidify. Air is then admitted under pressure to the receptacle containing the device, and the pressure maintained until the whole mass of insulating material has solidified. By this treatment, the presence of air or vacuous spaces in the dielectric, which are otherwise liable to form by the contraction of the insulating material when cooling, is prevented.

Any plan may be followed or apparatus used for securing the two conditions necessary to the attainment of the desired result; that is to say, applying the fluid insulating material in vacuum and subsequently subjecting it to or solidifying it under pressure. The degree of exhaustion or of pressure may vary, very good results being secured by a vacuum of about 29 inches and a pressure of about 100 pounds. It may be stated, however, that when hydraulic pressure is applied, very much higher pressures are readily secured and are of advantage.

In order to facilitate the carrying out of the process, I have devised a simple and useful apparatus, which is illustrated partly in section in the accompanying drawing. As the parts of said apparatus are all of well known construction, the apparatus as a whole will be fully understood without a full description of its details.

A is a tank or receptacle that may be closed air-tight. Within this tank is a steam coil C, surrounding a vessel B, preferably with slightly sloping sides and provided with a tube or pipe D, opening into it near its base.

The condenser or other device to be treated is placed in the vessel B, and around the receptacle is packed a suitable insulating material in quantity sufficient, when liquefied by heat, to flow through the pipe D into the vessel B, and fill the space in the latter up to the top of the condenser or other device placed therein.

It is desirable to run into the pipe D enough melted material to fill it before using the apparatus, and to make the pipe of a poor heat-conducting material, so that a little time will elapse after the heat is applied to melt the material in the tank A before the flow through the pipe begins.

When the apparatus has been thus prepared, the air from the interior of the tank A is withdrawn as completely as practicable by an air pump E, and steam is passed through the coil C. In order to prevent access of any of

the volatile constituents of the insulating material to the pump, a condenser F, with a cooling coil G, is interposed in the piping between the tank and pump. After a partial vacuum has been secured in the tank A, and the liquefied insulating material has been run into the vessel B, the pump may be stopped and the tank connected with a receiver H, from which the air has been exhausted, and the apparatus allowed to stand until all the interstices of the condenser have been permeated with the insulating material. The steam is then shut off and cold water passed through the coil C. The connections with the pump are then reversed and air is forced into the tank and receiver H, and the further cooling and solidification of the insulating material carried on under a pressure considerably greater than that of the atmosphere. After the insulating material has cooled and solidified, the condenser or other device, with the adhering mass of insulating material, is removed from the receptacle, and the superfluous insulating material taken off.

I have found that condensers, transformers and similar apparatus treated by this process are of very superior quality, and especially suited for circuits which convey currents of high frequency and potential. * * * *

The claim of the patent reads as follows:

The improvement in the manufacture of electrical devices, such as condensers, which consists in inclosing the device in an air-tight receptacle, exhausting the air from the receptacle, introducing into a vessel containing the device an insulating material rendered fluid by heat, and then, when said material has permeated the interstices of the said device, subjecting the whole to pressure, and maintaining such pressure until the material has cooled and solidified.

LATE NEWS.

The Buffalo & Niagara Falls Electric Railway Company reports for the quarter ended December 31, 1896, a deficit of $2,811, against a deficit of $1,699 for the same period in 1895. The balance sheet shows cash, $2,538; profit-loss surplus, $13,957.

The Hendersonville & Brevard, N. C., Telegraph and Telephone Company has been placed in the hands of W. E. Shuford, of Ashville, N. C., as receiver. The capital of the company is $250,000, and its funded debt is $150,000. Its lines extended from Hendersonville to Brevard, a distance of 21 miles.

A press dispatch states that, on the application of the Union Savings and Trust Company, of Cincinnati, Ohio, the Citizens' Traction Company, of San Diego, Cal., has been placed in the hands of A. D. Noman as receiver. The company is the successor of the San Diego Cable Railway Company, which was foreclosed in April, 1895.

Important, If True.

[*From the Boston News Bureau.*]

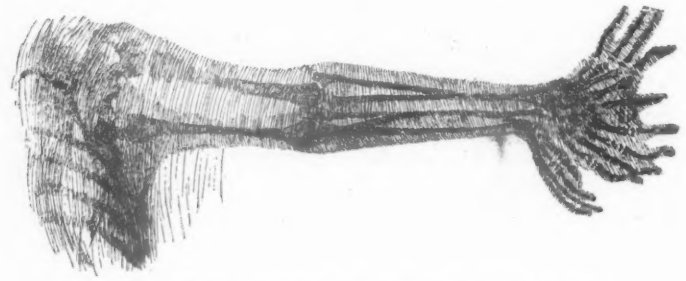
It is said that the real key to the General Electric situation at the present time is the question of the overhead versus the underground trolley systems. The overhead electric trolley wire companies threaten a boycott of the General Electric Company if it continues to forward the underground trolley system.

Radiograph of a Girl's Right Arm with Three Hands.

The accompanying illustration, from the New York *Herald*, is a pen-and-ink sketch of a very interesting radiograph of the right arm of a girl 11 years old. The girl is provided with three separate and distinct hands on the right arm, and the radiograph was made with the idea of showing the exact location of all the bony structure, with a view of performing an operation to relieve her of two of the hands.

The child is well known to the surgeons at the Polyclinic Hospital, in East Thirty-fourth street, New York city, all of whom are deeply interested in her case. She was first taken to the hospital in 1888, when she was only two years old.

The child was born with an abnormally large right arm and three right hands. Her parents desire to have the arm reduced to normal size and the superfluous hands removed. The surgeons believed the operation possible, but were never able to determine exactly what the internal conditions of the arm were, and could not be assured that the removal of two hands and the superfluous flesh and bones of the arm would not destroy the nerves and muscles that would be left and render useless the one hand that remained.



RADIOGRAPH OF A GIRL'S RIGHT ARM WITH THREE HANDS.

The X rays permitted the surgeons to see clearly all the bones in the arm and to know just what cutting would be necessary. Dr. George R. Fowler had charge of the case. He delegated Dr. S. Ormond Goldman to have photographs made. These were made by Frank Martin, an expert, and were exhibited at a hospital clinic last Thursday. It was then determined that a successful operation was possible, and that the hand and parts of the arm that would be left would be almost perfect, but that possibly the hand would not be as free in motion as a normal hand. The surgeons concluded that the operation might be performed at any time and that nothing would be lost by delay.

The report of the case states that the X-ray picture shows that there are in the girl's right shoulder, arms and hands one scapula, two glenoid fossæ, two humeri, articulating with the glenoid fossæ of the scapula; three ulnæ, two radii and three hands, having together 16 fingers, two of which are rudimentary.

The outer hand is nearer perfect, but lacks power in the thumb. One of the two elbow joints is slightly in advance of the other, thereby limiting greatly the normal flexion and extension, these movements existing only to a slight extent. Each hand moves independently of the others, and all can move in unison. The child has probably three centers on the left cerebral hemisphere of the brain.

Advances Made in Metallurgical Chemistry.

To the Editor of Electrical Review:

A recent article, giving the reduction of area of "flowed" steel as used by a most estimable firm of boiler makers in this country, as running from 35 to 60 per cent, calls the writer's mind to the physical qualities of the new "ductile cast-iron", also made in this country, tests of which have given the reduction of area from 34 to 60 per cent, unannealed with a correct tensile strength easily passing the government requirements.

This product can be sold for about one-half the cost price given for "flowed" steel.

A ruptured piece of "ductile cast-iron" showed a silky fracture similar to that peculiar to the virgin iron of Norway and Sweden.

HENRY S. PHILBRICK.

New York, February 26.

Telephone Exchange Fire In Des Moines.

The telephone company at Des Moines, Iowa, recently experienced one of the most disastrous exchange fires in its history. As a result, the switchboards, toll office, etc., were badly damaged, the exchange rendered useless for some time, and the company will be out several thousand dollars before the damage is repaired. The work of reconstruction is going on, but it will be some time before the exchange will be completely restored.

Chicago Electrical Association.

At the next meeting of the Chicago Electrical Association, on Friday evening, March 5, Mr. Kempster B. Miller will read a paper on "Electrical Resonance."

The plant of the Electric Power Company, at Livingston, Staten Island, which was one of Erastus Wiman's assets, was sold at receiver's sale by Albert B. Boardman. The property was purchased by Paul D. Cravath for the consolidated companies.

All the real estate and personal property of the Laconia Car Company will be sold at Laconia, N. H., by public auction, for cash, on March 11.

THE INCANDESCENT LAMP SITUATION.

EIGHT LAMP MANUFACTURERS HAVE SECURED LICENSES FROM THE WESTINGHOUSE COMPANY.

During the past year considerable interest has been manifested in the incandescent lamp situation as affected by patents owned by the Westinghouse Electric and Manufacturing Company. In last week's ELECTRICAL REVIEW mention was made of the fact that several of the incandescent lamp makers had secured licenses to manufacture under royalty lamps containing cellulose filaments, the patents on which are controlled by the Westinghouse company. Further information on this subject has since been obtained by the ELECTRICAL REVIEW from the officials of the Sawyer–Man Electric Company, which company conducts the incandescent lamp business of the Westinghouse company.

The Westinghouse Electric and Manufacturing Company is the owner of a large number of patents relating to incandescent lamps and the processes of manufacturing them. The following companies have been granted licenses by the Westinghouse company and are now operating under these patents, viz.: Bryan–Marsh Company, the Perkins Electric Switch Manufacturing Company, the Columbia Incandescent Lamp Company, the Buckeye Electric Company, the Sunbeam Incandescent Lamp Company, the Adams–Bagnall Electric Company, General Electric Company, New York & Ohio Company.

It is further understood that the Westinghouse company is prepared to grant licenses upon equitable terms to other reputable manufacturers of incandescent lamps, and that several are now negotiating for them. Newspaper statements have appeared from time to time to the effect that a pool has been formed among certain lamp manufacturers. The officials of both the Westinghouse and Sawyer–Man companies state that they are not members of any such pool, but are continuing the independent manufacture and sale of incandescent electric lamps. Other rumors, to the effect that the Westinghouse company has gone entirely out of the incandescent lamp business, are denied by the officials. This rumor may have arisen from the fact that the Westinghouse company does not itself manufacture incandescent lamps, having about a year ago reorganized the Sawyer–Man company, one of its controlled companies, and transferred its incandescent lamp business to that company.

It is understood that the only lamp manufacturer who will not be affected by the Westinghouse patents is the latest comer in the field, the Shelby Electric Company, of Shelby, Ohio. All the filaments used by this company are, it is said, imported ready for use from Europe. The company has a brand new factory and expert employés, with a New York branch, and promises to become an important factor in the lamp business.

Catalogue of House Goods and Telephone Supplies.

The latest catalogue from the Central Electric Company, of Chicago, is a thoroughly business-like production. It will delight every local supply dealer who gets it. Catalogue No. 4 is devoted chiefly to house goods and telephone supplies. Its varied and many headings comprise annunciators, bells and buzzers, push-buttons, batteries, electric gas-lighting supplies, fire and burglar alarms, telegraph instruments and electric door-openers. These are a few of the articles illustrated, clearly described and priced. In addition, Okonite wire and products have special mention, and tools and construction material (important just now) are presented fully, as is also a comprehensive list, well illustrated, of telephone supplies. Electric heating and cooking apparatus, incandescent lamps and X-ray apparatus are enumerated, and valuable, practical tables and diagrams conclude the descriptive text. Catalogue No. 4 is a noteworthy publication, and every dealer in electrical merchandise will thank the ELECTRICAL REVIEW for calling attention to it—if he sends for a copy.

For the first time appears in the literature of the Central Electric Company the dates "1887" and "1897", a decade of successful business being thus briefly indicated.

Up-to-Date Financial News Service.

[*From the Wall Street Journal.*]

We have concluded an agreement with the Printing Telegraph News Company, operating what is known as the page ticker, by which we lease the entire operating plant of that company for a term of years and assume control of the distribution of news over the page ticker. Our object in doing this has been to round out and perfect our present service. It has become necessary to give both a full service and an instantaneous service. There are certain news matters which derive their whole value from instantaneous delivery. For these, the page ticker has no equal. For more extended matter, tables, analysis of reports and official announcements, our bulletin service is much to be preferred.

We believe that the close competition in business among brokers, resulting from the extensive use of private telephones and private wires, will make it to the advantage of very many houses to take both services—the ticker service for private wire use and for short, quick matter, the printed slips for the general use of customers.

LITERARY.

The present agitation concerning trusts gives additional interest to a contribution by V. H. Lockwood in the *North American Review* for March, entitled "How to Reform Business Corporations." Two carefully prepared methods are advocated by Mr. Lockwood to prevent the mismanagement of corporations and to secure the rights of small shareholders, while the entire ground of the duties and liabilities of directors and officers is succinctly gone over.

ITEMS OF INTEREST.

Greeley, Colo., is investigating the cost of a municipal electric lighting plant, to be erected before next July.

Boston elevated railroad people are securing signatures in favor of that system of rapid transit for Boston. Many thousand names have already been secured.

The Penn Yan, Keuka Park & Branchport, N. Y., Railway has been incorporated to operate an eight-mile electric road in Yates County. Capital, $100,000.

Judge Showalter, of Chicago, has entered an order authorizing the receiver of the Chicago & Englewood Electric Street Railway Company to issue $60,000 of certificates of Series A and $265,000 of Series B, to pay lienors and complete the storage battery system of the road from Sixty-fourth street along Vincennes road to Blue Island.

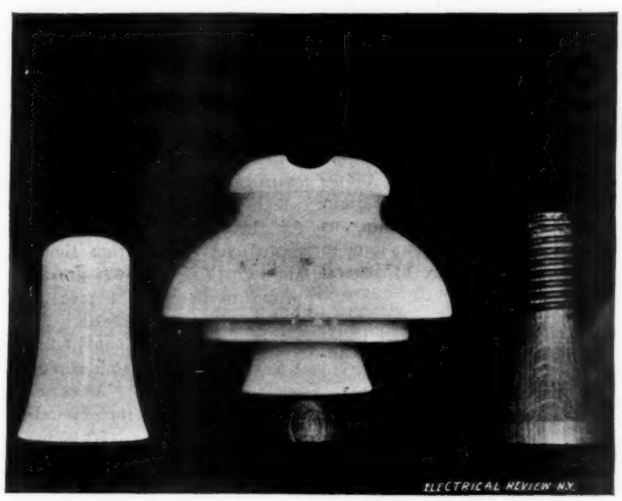
Mr. D. P. Erwin, proprietor of the New Denison hotel at Indianapolis, is considering plans for a new heating system for the hotel. The architect employed has been making a special study of electrical heating recently, with a view to preparing specifications which shall embrace this system for the Denison, if the system is found to be advantageous.

A correspondent of the *American Machinist* writes as follows: I note in your issue of February 4 a short notice of a sawmill driven by electricity from the Folsom-Sacramento plant, with the remark that this is reported to be the first electrically-driven sawmill. I would like to call your attention to the fact that in the issue of November 5, 1896, of *Der Praktische Maschinen Constructeur*, Leipzig, there are given plans and descriptions of a sawmill, where each separate machine is independently driven by electricity.

The question of granting a franchise for a street-car line through Holland, Mich., without the insertion of a clause restricting Sunday operation, has been introduced into the pulpit. Recently the Rev. H. G. Bichby, pastor of Hope Church, gave a talk on the subject. He declared that those who patronized street cars were exerting their influences to compel Sunday labor, and intimated that, should street cars be allowed to run on Sundays, that would be a first step towards having the factories and city stores open on the first day of the week.

New Forms of High-Voltage Insulators.

The insulator shown in the accompanying illustration is one of the new "Locke" designs, which is made for carrying a very high voltage; in fact, up to 50,000 volts, and this particular form of insulator has stood for four hours 70,000 volts without arcing, breaking down or heating. It is of triple-petticoat form and is made in two parts, the outer porcelain and the inner cup glass, or it is made with both outer and inner of porcelain. The idea of using glass is to prevent puncture, as glass, as it is generally known, is the most perfect insulator in this respect, and the outer porcelain prevents leakage, this combination accomplishing the highest results in the matter of insulation. The type which has both porcelain for the outer and inner, it is claimed, that as each part may be thinner, permits better vitrification throughout. In combining the two portions, they are both screwed and fused together. These insulators are mounted on steel pins, with locust tips, and boiled in paraffine. Since the successful transmission of high power at Niagara Falls, there has been a new demand for these high-voltage insulators, and Mr. Fred M. Locke, of Victor, N. Y., manufacturer, reports a great number of companies which are equipping with them.



LOCKE'S NEW FORM OF HIGH-TENSION PORCELAIN INSULATOR FOR CARRYING 50,000 VOLTS.

A New Arc Lamp Company.

The Ajax Lamp Company, of New York city, has been incorporated, with a capital stock of $100,000. The directors are Bernard F. Pomeroy, Ernest Woltmann, Luther E. Shinn, David H. Gildersleeve Henry A. Kirkham and Jacobi Loewenthal, New York, and Charles S. Van Nuis, New Brunswick, N. J.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY.

AN OLD FIRM WITH A NEW NAME.

The Bullock Electric Manufacturing Company, Cincinnati, Ohio, is the new name of a firm which has been well known in the electrical field for several years as the Card Electric Motor and Dynamo Company.

At the annual meeting of the company, on February 15, this change in the name was made for two reasons: First, the old name was a little long; and, second, there was another company doing business in the State of Ohio under a name which, while not exactly the same, was so similar as to cause a great deal of annoyance. The new company, as far as the management is concerned, is exactly the same as the old one. The only difference is in the name. At the annual meeting the directors chosen were George Bullock, J. W. Bullock, G. Nelson Stone, P. R. Mitchell, J. S. Neave and G. W. Wilshire. Mr. George Bullock was elected president and treasurer of the Bullock Electric Manufacturing Company, and Mr. J. S. Neave was elected vice-president and secretary.

For the control of the selling of this company's apparatus in the East, the Bullock Electric Company has been organized by Mr. George Bullock and Mr. Robert Lozier, who has been the company's eastern representative for some time. The Bullock Electric Company's main offices are in the new St. Paul Building, New York city, with branches at 8 Oliver street, Boston, and 665 Bourse Building, Philadelphia. Authorized agencies have also been established in Chicago, St. Louis, Louisville, Atlanta and Spokane. Bergtheil & Young, of London, are the representatives of the Bullock Electric Manufacturing Company in England.

Mr. Bullock and his associates have lately made an aggressive plan of campaign for the rapid and universal introduction of their high-class apparatus and will soon be prepared with new catalogues of their goods. The offices of the Bullock Electric Company, in the St. Paul Building, New York city, form one of the most elegant suites occupied by any electrical company in the East. The people connected with this company are all gentlemen of experience, and this fact, taken in connection with the high-class product of the company, should assure to it full success.

Visitors at N. E. L. A. Headquarters.

The following named out-of-town visitors registered at the headquarters of the National Electric Light Association, 136 Liberty Street, New York city, during the week ended February 26: F. B. Donahoe, Chicago, Ill.; G. W. Vallee, Philadelphia, Pa.; Jas. Bradley, Boston, Mass.; E. A. Colby, Newark, N. J.; C. E. Scott, Bristol, Pa.; H. H. Swetland, Fredonia, N. Y.; W. D. Sargent, Brooklyn, N. Y.; C. F. Mundor, Springfield, Mass.; A. H. Pease, Hartford, Ct.; I. R. Prentiss, Cleveland, Ohio.

SCIENTIFIC NOTES OF INTEREST.

M. P. de Heen, aware of the fact that electricity can produce impressions on a sensitive plate without the aid of light, and also that currents of air containing particles of water or fine dust produce electricity when they impinge on a solid substance, has experimented with an air current charged with Lycopodium powder allowed to fall on a sensitive plate, and a photograph thus obtained appears in the *Bulletin* of the Belgium Academy.

Mr. James I'Anson publishes some results he has obtained by experimenting with charged conductors and sensitive plates, securing perfect images of the invisible electric discharge without the plates being exposed to either X rays or light. The electrified streams of air driven off by the discharge appear to act upon the plate exactly as light does. It is thus possible to secure impressions of such discharges by simple electrification and subsequent development.

In Paris the subject of painless execution is being discussed again, and M. Berthelot, the distinguished chemist, is credited with the opinion that the lethal chamber, using ordinary coal gas, is a suitable method. Electrocution is not considered satisfactory even in America, and asphyxia, which was really suggested many years ago by the experiments of Dr. Angus Smith, is thought to be the best means. Perhaps the discussion may lead to the abolition of capital punishment altogether.—*London World of Science.*

The detection of inflammable gas and vapor on board ship formed the subject of a paper by Prof. F. Clowes, in which the author stated that to avoid the accidental firing of explosive atmospheres on board ship from other sources than hand lamps, as well as to prevent personal risk from entering and breathing atmospheres charged with combustible gas or vapor, it was advisable to apply to such places tests suitable not only for detecting inflammable gas or vapor, but also for estimating the proportions which might be present. For this purpose the miner's safety lamp presented great advantage over electric hand lamps. The electric lamp gave no indication of a dangerous condition of the atmosphere, while the suitably-fitted safety lamp gave the most ready, trustworthy and delicate tests for such dangerous gas or vapor in the air. If the flame of a safety lamp was extinguished when it was carried into air containing combustible gas or vapor, the atmosphere was almost certainly in an irrespirable and explosive condition, and the space should not be entered until the atmosphere had been completely replaced by ventilation. The ordinary oil flame of a safety lamp also showed the presence of inflammable matter when it was present in the air in too small a proportion to cause extinction of flame. The most delicate tests available, however, were furnished by substituting for the ordinary oil flame of the lamp a pale hydrogen flame.

NEWS OF THE TRADE.

The Ball Engine Company, Erie, Pa., are building a number of the vertical types of engines for early installation in electrical plants.

Genor & Colburn, 97 Washington street, Buffalo, N. Y., have perfected a new dry battery which has a number of features that will recommend it.

The electric light and power companies of St. Louis, Mo., that go into the underground conduits, will be called upon to put up about $75,000 as security that they will restore the streets to their former condition.

The factory of the Adams–Bagnall Electric Company on East Prospect street, Cleveland, certainly shows sufficient indications that the new era of business activity has begun. Their modern types of arc lamps have quickly gained recognition.

The Willard Electric and Battery Company, Cleveland, Ohio, seem to be meeting with marked success in the introduction of the "Willard" storage battery. President Willard said that the factory on Wood street was taxed to its capacity, and the company have in sight a number of promising orders.

The well known "Buckeye" incandescent lamps easily maintain their popularity, and the Buckeye Electric Company, in their factory at Cleveland, have recently perfected certain improvements in filament-making, as mentioned in a recent news item in these columns, which are of general interest.

The Shelby Electric Company, Shelby, Ohio, manufacturers of incandescent lamps, have just completed the construction of a most perfectly planned factory, which will have every equipment for the making of lamps. The building throughout will be fully departmentized and every process in lamp-making will be conducted in individual shops. The company also have a complete chemical laboratory and a physical laboratory, with an elaborate line of the standard American and French instruments. In an interview with Secretary Fish, a representative of the ELECTRICAL REVIEW was informed that their production of lamps would be of the highest grade.

The Kirk–Latty Manufacturing Company, Cleveland, Ohio, into which has been merged the Williams & Abbott Electric Company, which had become most favorably known in the telephone field as makers of a high-grade magneto bell, have recently moved into a much larger factory in the west end. In addition to greatly increased facilities for the production of their standard lines of tacks and nails, of which they have a daily capacity of over two cars, the Kirk–Latty Manufacturing Company are equipping several large shops for their telephone work. So much space will be given the electrical department, in fact, that they will be able to produce about 1,100 magneto bells weekly. The Messrs. Williams and Abbott will both retain an active interest in the business.

SOME RECENT DEVELOPMENTS IN COPPER MANUFACTURE.

BY HAROLD P. BROWN.

In these days of keen business competition, makers of electrical apparatus and machinery are quick to seize upon each advance in the arts which will reduce the cost of material or increase the daily output of their shops. And the alert engineers in our large electric power houses are always ready to adopt improvements which will effect a saving of power. Both of these classes will, therefore, be glad to learn of a discovery in metal handling which will reduce cost and save time and power. It has been considered impossible to obtain solid castings of copper without mixing with it some other material.

And it is well known that even one-half of one per cent of alloy is enough to reduce the electrical conductivity of the casting to one-quarter that of pure copper. Many processes of mixing or tempering this metal have been invented, but their product has not up to this time been able to show the physical properties of rolled or drop-forged copper.

Some months ago, in a new type of rail bond, I used strips of rolled copper with cast-copper terminals. These castings were made for me by a firm which claimed extraordinary things for their product. I therefore expected very little from the metal, and in making tests was greatly surprised to find that a piece of this metal, with but three-eighths of a square inch section, could transmit 1,500 amperes for 20 minutes without excessive heating. A calculation based on this performance indicated a conductivity of at least 90 per cent that of the best rolled copper. As I had never before found cast copper with more than 40 per cent conductivity, I decided to make a thorough and complete series of tests, so as to ascertain the facts concerning this metal, which is called MB copper. A chemical test suggested by Mr. Edison showed that these castings had less impurity than was contained in some sheet or rolled metal sold as pure electric copper. To exactly determine the relative conductivity, I ordered a pattern made, from which I obtained castings of the best commercial copper and of the MB metal.

These castings were carefully finished, so as to present for testing a cylinder 25 inches long and 0.8 inch in diameter; a terminal was left at each end, about two and one-quarter inches by two and one-quarter inches by one inch.

As a basis for comparison, I had an exactly similar bar turned up from the best rolled Lake Superior copper. The completed bars were magnificent pieces of metal, without an apparent flaw. The difference in shrinkage of the two castings and a slight variation in the size of the terminals made it impossible to exactly obtain the comparative weight. The terminals of the rolled bar measured two inches by two and seven-sixteenth inches by one inch, and its weight was seven pounds six ounces.

The commercial cast bar was a popular process "tempered" copper with terminals two and one-sixteenth inches by two and one-eighth by one inch; its weight was six pounds nine ounces.

The MB bar's terminals measured two inches by two and three-sixteenth inches by one inch, and its weight was seven pounds one ounce. Each of the cast bars gave a clear musical tone when suspended and struck; the MB bar, though the heavier, gave the higher tone. Of course, the rolled bar was without resonance. The commercial cast bar had accidentally been turned 0.002 of an inch too small, but the other two measured exactly 0.8 of an inch, thus having a section of practically one-half a square inch.

I decided to test the electrical drop, in two feet of each bar, and its temperature at from 100 to 1,500 amperes, the latter being three times the proper current for that section of copper. In order to prevent any rise of temperature from the contacts at terminals, each terminal was amalgamated by the Edison process and coated with the Edison flexible solder; there was, therfore, no appreciable drop at these contacts. In amalgamating the commercial copper bar by the Edison process, fumes were given off with an odor of zinc, and a black precipitate was formed. This was washed off and the process repeated several times, until the surfaces remained bright. Both of the other bars yielded instantly to the process without fumes or precipitate.

Mr. Edison states that this is a keen test of the purity of copper, and so it proved, for the analysis subsequently made for me by the Ledoux Company showed the commercial casting to have 99.15 per cent of copper; the rolled bar 99.83 per cent and the MB 99.85 per cent.

In spite of the different characteristics of these bars, the variation in composition is less than seven-tenths of one per cent.

From tests of similar samples, the tensile strength of the commercial cast copper was 19,000 pounds to the square inch, while the MB was 30,000 pounds, which is practically the same as rolled copper.

The cables used for connections were 500,000 circular mils, with triple braided insulation. When heavy currents were used, the bare ends of the cables near the bar connections were cooled with wet waste.

The observed temperature of the bars was, therefore, not due to any outside cause. The instruments used were all made by Weston, and comprised a shunt ammeter, reading up to 1,500 amperes; a millivoltmeter, reading 0.0002 per degree up to 0.01 volt; another, reading 0.002 per degree up to 0.1 volt, and a third, reading 0.01 per degree up to 1.5 volt. In each case the same voltmeter terminals were used; these were clamped upon amalgamated spots on the bars, just 24 inches apart.

A special dynamo driven by Edison motors was used; its field was excited from the Edison mains; by using a rheostat and a bank of lamps, the amount of current generated could be accurately adjusted.

The first readings were taken at 100 amperes after about one minute's run; the current was then increased 100 amperes and a second reading taken, and so on until 1,500 amperes were reached. This amount of current was continued for 10 minutes, and increase of the temperature and drop noted. The bars were then disconnected and laid upon a wooden floor and their rates of cooling noted. Since the copper resistance tables are either calculated for a constant temperature or were compiled years ago from data based on impure copper, I decided to use as a base of comparison the drop of the rolled

copper bar at each 100 amperes. Since the performance of the MB copper came so close to this standard, I repeated the tests on each and found the readings accurately recorded.

The tabulated results are as follows:

Amperes.	Rolled Copper		MB Copper.		Commercial "Tempered" Cast Copper.	
	Deg. Fah.	Mil. V.	Deg. Fah.	Mil. V.	Deg. Fah.	Mil. V.
100	72	.003	72	.005	72	.010
200	74	.0065	72	.007	74	.020
300	76	.0105	72	.011	75	.027
400	78	.0164	72	.014	79	.046
500	79	.017	72	.017	80	.060
600	80	.0195	72	.020	82	.071
700	81½	.0225	73½	.023	86	.096
800	83	.025	73½	.026	91	.116
900	88½	.028	73½	.0285	96	.130
1,000	94	.06175	74	.084	104	.145
1,100	96	.035	76	.036	110	.165
1,200	98	.042	76	.044	118	.1805
1,300	98	.046	79	.048	126	.1995
1,400	90	.048	81	.052	135	.220
1,500	138	.053	136	.057	354	.340

The last set of readings was taken after a 10 minutes' run with 1,500 amperes.

The accompanying curves will show the behavior of the three metals under exactly the same set of conditions. The commercial cast copper averaged less than 28 per cent conductivity, and before the end of the run, scorched the wood on which it rested and the cotton covering the thermometer bulb, as it reached 354 degrees Fahrenheit and 0.22 of a volt drop. Before the test the color of this piece was fine and closely resembled that of the other bars; after the test the bar was a mass of red and silver colored spots, and had lost nearly all its resonance. At the end of the run it had expanded from increase of temperature one-eighth of an inch in 24 inches and 0.002 of an inch in diameter.

Allowance should be made for its difference in size. It required 2 hours and 20 minutes to cool to the temperature of the room. The rolled copper showed a conductivity far greater than called for by the tables ordinarily used. Its actual resistance per foot at 72 degrees Fahrenheit was 0.000015 ohm. In the table published by the London *Electrical Review*, the resistance of a piece of copper 95 per cent pure, one foot long, with a section of one-half of a square inch, is said to be 0.00001706 at 60 degrees Fahrenheit. Without reducing to the same temperature, the latter resistance is 13.7 per cent greater than the resistance observed. The tables based on the Matthiessen standard conductivity also show greater resistance. It is, therefore, wise to use an actual measurement of modern rolled copper as a standard of resistance for cast copper. The rolled copper bar at end of the 10 minutes' run, with 1,500 amperes, reached 138 degrees Fahrenheit and 0.053 volt. It had then increased one-eighth of an inch in 24 inches, as did the other, but the diameter increased 0.0005 instead of 0.002 of an inch. It required 1 hour and 23 minutes to cool. The performance of the MB copper was a surprise, and remains a puzzle. In the test, it kept 8 to 10 degrees cooler than the rolled bar up to a load of 1,400 amperes. At the end of the 10 minutes' run, with 1,500 amperes, it reached 136 degrees Fahrenheit and 0.056 volt. Its increase of size was the same as that of the rolled bar.

It required 1 hour and 39 minutes to cool. The varying temperature of the two bars evidently accounts for the up-and-down movement of the efficiency curve between 94 per cent and 97½ per cent. If in the tests the temperature of the bars should be kept at 72 degrees by allowing time for cooling after each reading, it is my opinion that this curve would be practically a straight line at 95 per cent or 96 per cent. I need not say that this conductivity is marvelous, and opens an entirely new field for dynamo and motor construction and for switchboard work, where a large saving can be effected by using it in place of rolled or drop-forged copper, both of which will warp or twist when heated, while the finished cast metal retains its shape. I know of large multipolar dynamos upon which castings of low conductivity have been used for field coil connectors, etc.; on account of the unsuspectedly high resistance of these contacts, the calculations concerning compounding have been upset and the dynamos have been failures. Another surprising quality of these MB castings lies in their elasticity. I have fastened in a vice one end of a casting one inch wide and three-eighths of an inch thick; the other end, 12 inches distant from the point of support, was bent one inch out of its position, but sprung back when released. I have driven through a seven-eighth-inch hole in a hardened steel plate a plug of MB metal fifty-seven-sixty-fourths of an inch in diameter. This required as many hammer blows on the fifth trial as it did on the first.

In another experiment I drove into an opening one and nine-sixteenths of an inch wide, between heavy steel rails, a plug of MB copper cut in two pieces lengthwise, the sum of whose widths was one and nineteen-thirty-seconds of an inch, thus compressing the metal one-thirty-second of an inch. A current of 1,500 amperes was then passed through the junction, whose section was three-eighths of a square inch, and a drop of 0.018 volt was indicated from rail to rail through the two copper pieces in series. The rails were then separated one-thirty-second of an inch more, but the drop remained the same, showing that the copper had resumed its previous width. An analysis of another sample of this MB copper gave the following results:

Copper	99.870 per cent.
Silver	.034 "
Iron	.011 "
Arsenic	.002 "
Zinc	.013 "
Tin	None.
Bismuth	None.
Lead	None.
Cobalt	Trace.
Sulphur	None.
Oxygen (by diff.)	.068 per cent.

This analysis is verified by others made by such experts as Ledoux & Company, Booth, Garrett & Blair, Prof. Frank X. Moerk and others, and shows exactly the same results as the best Lake Superior copper. It is evident that no alloy has been used; and, yet, the process has increased the electrical conductivity and the tensile strength; has given a certain amount of elasticity and decided resonance; has increased the density and changed the structure of the metal.

On presenting this matter to Mr. Edison, he accounted for the evident change in the structure of the metal by the theory that the shape of the crystals has been altered so that their lines are parallel and that the molecules are thus brought closer together and into more intimate contact with each other.

The fact that MB copper can also be rolled or forged adds new interest to its development. As its tensile strength exceeds that of ordinary copper wire, it is certainly worth while to make wire from it, in order to determine its strength and conductivity. If it is possible by this process to make as large an increase in the conductivity of wire as it has made in conductivity of cast copper, it will revolutionize dynamo and motor building, and every electric light and railway company will save money by using it to replace its present line wire. And if the tensile strength of the wire is increased by the process, poles can be set further apart, and the wire will be less likely to decrease its diameter during Winter. This metal is well worth the attention of all electrical engineers who appreciate the value of high conductivity.

It is understood that Mr. Edison is interested in the development of the process, and that the MB copper will be manufactured under his supervision at the celebrated Menlo Park works.

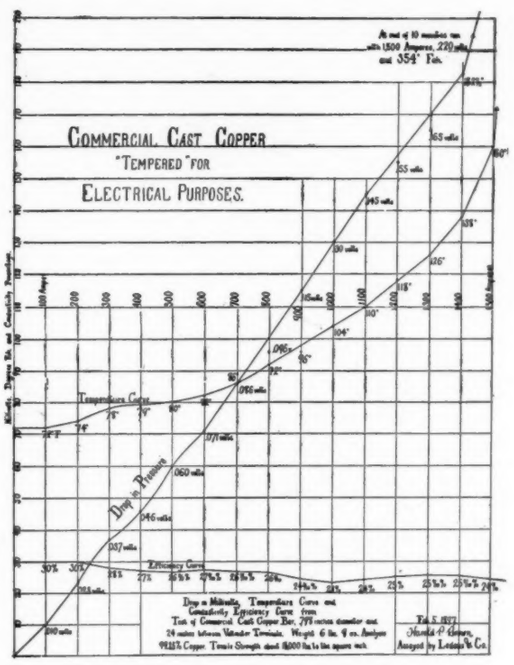


FIG. 1.—TESTS OF COMMERCIAL CAST COPPER.

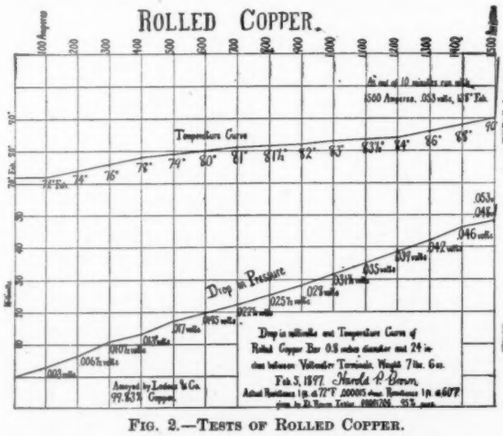


FIG. 2.—TESTS OF ROLLED COPPER.

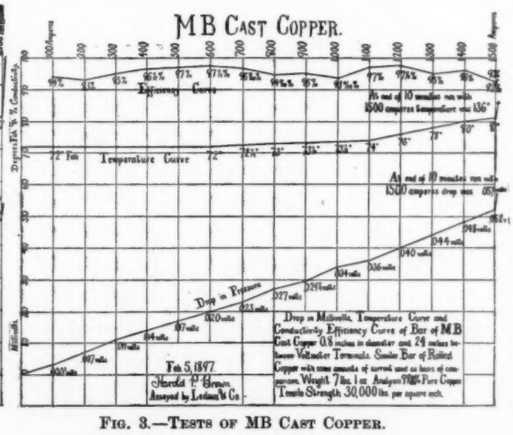


FIG. 3.—TESTS OF MB CAST COPPER.

Electrification of air by Roentgen rays has been accomplished by Lord Kelvin, with whom have been associated in his experiments Dr. J. C. Beattie and Dr. M. Smoluchowski de Smolan. In the apparatus the air was drawn, by means of an air-pump, through a lead cylinder closed at both ends with paraffined cardboard transparent to the Roentgen rays, and thence through an electric filter. In every case the air drawn through the filter was found to be negatively electrified when no screen, or an aluminum screen, was interposed between the Roentgen lamp and the near end of the lead cylinder, but the interposition of a lead screen prevented electrification. A very decided electrification of air—sometimes negative, sometimes positive—was also observed when the Roentgen rays were directed across a glass or aluminum tube, through which the air was being drawn from the quadrangle outside the laboratory to the filter.

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CHANGES for advertisements must be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week.

NEW YORK, MARCH 3, 1897.

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The busiest telephone exchange in the world is in Chicago. It is the Washington street exchange, where the daily average is about 180,000 messages, which means that double that number of persons talk over the telephone lines.

VICE-PRESIDENT HOBART'S BUSINESS CONNECTIONS.

Mr. Garret A. Hobart, the new Vice-President of the United States, is a gentleman who has for many years been connected with industrial and other business enterprises. In view of his election to a high office in the Government, it is stated that Mr. Hobart has resigned from many companies and corporations in which he was an officer, so that he may enter upon his public duties unhampered. Just what offices he has resigned is not at this time known. Mr. Hobart is, or was, president of the Passaic Water Company, the Paterson Railway Company, the Central Electric Railway Company, and the Morris County Railroad Company, and is director or officer in all the important companies formed to bring water to the cities of his section. As director his name appears in many concerns, among which are the Edison Electric Illuminating Company, Paterson, N. J., the New York, Susquehanna and Western Railroad Company, the Lehigh and Hudson, the First National Bank of Paterson, the Paterson National Bank and the Paterson Savings Institution, the Barbour Bros. Company, the Barbour Flax Spinning Company, the Pioneer Silk Company, the Butler Hard Rubber Company, the People's Gas Light Company of Passaic, and many others.

The first use of the X rays as evidence in the courts of Ohio will be in a suit for personal damages. Judge D. C. Badger, in Common Pleas Court, at Columbus, has ordered Patrick McGraw, plaintiff in a suit for $10,000 personal damages against John R. Hughes, to submit to an examination by X rays to ascertain the nature of the bone fractures he claims to have suffered through the breaking of an elevator owned by Hughes. Judge Badger overruled a demurrer based on the claim that the examination would be detrimental to McGraw's recovery.

In the announcement of a play of this season is the statement that "130,000 volts of electricity" form part of the attraction. The play is, of course, a brilliant success. Such voltage should overcome all retardation on the part of those inclined to remain away.

There is a new Richmond in the incandescent lamp field that evidently will not have to pay royalties on account of patents on filaments. This company imports them ready for the bulb.

Electricity would cure the curve difficulties of the Broadway street car line.

Niagara Falls, N. Y., is to be the great convention city for electrical interests this year. The National Electric Light Association, the Association of Edison Illuminating Companies and the American Street Railway Association will hold their annual conventions at that point. The Street Railway Association is to have an extensive exhibition.

The daily press states that a company recently incorporated in New Jersey, with $50,000,000 capital, for the alleged purpose of manufacturing cornstalk products, such as cellulose, is in a reality a sugar company designed to be a rival of the American Sugar Refining Company. The report also avers that sugar is to be made from cornstalks by an electrical process. Seems to us we've heard before of making sugar by electricity, haven't we?

PERSONAL.

Mr. John Otis McFadden and Miss Isabelle Ridlon, daughter of Mr. Frank Ridlon, of Boston, were married at Roxbury, Mass., on February 24. The ELECTRICAL REVIEW extends its congratulations.

Mr. H. E. Hershey, general manager of the Harrisburg Foundry and Machine Works, of Harrisburg, Pa., has been at the Hollenden Hotel in Cleveland for several days supervising the installation of several plants in that vicinity.

Mr. Webb C. Hayes, of the National Carbon Company, and Mr. Russell B. Harrison, president of the Terre Haute Street Railway Company, sons of former Presidents of the United States, have been appointed special aides on the staff of the Grand Marshal, Horace Porter, for the inaugural ceremonies.

The many friends of Mr. Silas A. Barton, an ex-director of the General Electric Company, and for some years associated in other capacities with that company, will regret to learn that he has made an assignment. The recent failure of the Chicago Interior Decorating Company, in which Mr. Barton was the heaviest stockholder, was the immediate cause of his assignment.

Mr. George H. Lewars, the assistant treasurer of the Westinghouse Electric and Manufacturing Company, who has been connected with the Westinghouse interests for the last 10 years, has resigned with the electric company and accepted the position of general manager with the Curtis Publishing Company, of Philadelphia, publishers of the *Ladies' Home Journal*. The ELECTRICAL REVIEW wishes Mr. Lewars full success in his new field.

DISCUSSION ON "ELECTRICITY FROM CARBON WITHOUT HEAT".*

President Emery: The information contained in the lecture, and the manner in which it has been illustrated, has been very interesting. It has been a revelation to me, and I know that others have been much pleased, and we will open the subject for discussion unless first there may be some questions that members present would like to ask Mr. Case, which he will be glad to answer. I was not aware that we had gotten so far along as we have. These suggestions are valuable, and ought to be carried out along these lines. There is never any harm in following correct principles to the bitter end; those that start off without having the proper foundation fall away. The subject is now open for general consideration.

Mr. Siebold: I ask if it is necessary to keep adding the salt in order to keep up the electro-motive force of the cell.

Mr. Case: Yes, sir, in these cases.

Mr. Siebold: Is not that costly salt?

Mr. Case: It is too expensive for practical use. It is simply intended to illustrate the principle that you can oxidize carbon without heat. This battery will oxidize carbon without heat. It gives a low electro-motive force. We have oxygen here, in unstable compound, and which can be extracted in a vacuum. Here it is in an unstable condition, explosive. The point is to find something between the two.

Mr. Kerr: I ask Mr. Case if he has tried any other substance than the platinum for his electrode. As I understand it, platinum would be very expensive. Have you tried any other metal which will give you a comparatively high electro-motive force?

Mr. Case: No, sir; I have not tried any other metal. I do not know of any other metal which would maintain itself under those conditions.

Mr. Kerr: The combination of the sulphuric acid and chlorate of potash—

Mr. Case: Make peroxide of chlorine and several other salts.

Mr. Kerr: At the present time you only have one metal which will resist the action?

Mr. Case: That is the only one I know of. There may be others. I took the one most stable and which would not lose weight. I wanted to give evidence of the fact of oxidizing carbon without heat. It is not the question of the practical value. I thought platinum was the most durable thing I could use. The carbon represents the zinc in the ordinary battery.

President Emery: Mr. Case has been showing the results of a scientific investigation, and not those which were designed primarily for a commercial success. There is a great difference. All our noted scientists have first worked along scientific lines and achieved certain results independent entirely of commercial application afterwards. They have had the higher aim, instead of what we may call the baser one, although the commercial application must in the end follow the scientific investigation. This shows us a direction for investigation, and I am sure all of you will appreciate it for that reason. I am sure there are many present who must be interested in this subject.

Mr. C. S. Bradley: Mr. Case has very kindly mentioned a work that I did, beginning in 1882, at the old Pearl street station of the Edison Company. The results at that time did not encourage us to go forward. The subject has a great many difficulties which did not seem to occur to Mr. Jacques. The accumulation of the ash from the coal was a very serious matter, and will in time clog the battery. Also, after a short time, we found that the electrolyte became hardened. We supposed that it was due to the formation of carbonate of soda. It might have been due to that cause or it might not. We did not have any chemist present and therefore did not analyze the matter. Chemistry has not as yet afforded the means or shown a way, or we have not ingenuity enough to see the way, to find substances which could be readily separated from the ash, and at the same time would not absorb the carbonic acid developed by the carbon in its combustion.

I feel much like an old horse at a three-year-old race, and rather out of it now, in view of all that Mr. Case has done. He has reached rather a bloody end, but I hope that will not be the ultimate end. I feel a little afraid of that peroxide. We may reach that end before we get away from here. Oftentimes a lecturer brings out points which he did not anticipate; and it seems to me that the physician will be largely interested in this subject as it has been demonstrated here. It is a beautiful field of thought—the investigations of the relations of life; its mode of being sustained, and it seems to me like a great step, and a very interesting one, indeed. I have no doubt that some physicians are aware of this principle, but have not followed it from this standpoint. It often depends on the point of view we take of a subject, and this seems a beautiful one, not only from the point of view of producing direct conversion of heat, but it shows how simple human life probably is. It is usually so complex a subject that it is a complete mystery; but if simplified, if each step is seen in all its simplicity, the mystery would, in all probability, vanish.

Mr. C. O. Mailloux: The bloody side of this lecture is to me one of the most interesting that can be shown. It takes me back about 20 years, to a time when I was a student at Harvard Medical School, much engrossed in hemoglobin. This substance at that time was principally imposing on account of its name, and not on account of any knowledge we had about it. It was given to us by the professor as a sort of mysterious substance, which has a great deal to do with human life and an important thing in the human economy. I will state, for the information of the gentlemen present, that I passed the highest in our class in physiology. This statement presupposes that I knew at least as much as anybody about hemoglobin; but I am free to say, after what we have seen and heard here to-night, that what I suspected at that time was true, namely, that I knew nothing about it, and the professor himself did not know much about it. If he were here this evening he would open his eyes in astonishment at the intensely scientific and interesting revelation made to us by Mr. Case.

This question is far more significant than it seems to be on the surface. It not only reaches far into the problems of physics, but there is opened a new avenue into the realm of physiology, which is one, as my friend Mr. Bradley has said, that ought to be brought to the attention of the medical fraternity, if it has not already been done. The medical man has been for years, ever since my school days, groping for knowledge in regard to hemoglobin and the constituents of food concerned in the production of energy. We had at that time got so far as to be able, by means of a calorimeter, to determine the percentage of energy given out by the human body; in other words, we had gotten so far as to determine the efficiency of the human machine, and some of the laboratory work which I did was in that connection; but as to the rationale of the conversion of energy we knew absolutely nothing; and while I have long since lost all knowledge of a medical character, I feel this evening as if there had been brought before me a very considerable fund of useful and interesting knowledge.

Another aspect of this important point is the instructive fact, demonstrated to us once more in another manner—the peculiar manner in which energy acts, the peculiarity of energy, that it must be transmuted into one of many forms, and if it does not appear in one form it appears in other forms. I read some years ago, in connection with some work relating to batteries, the title of which I do not remember, an interesting hint of an important scientific fact, which appears to us, as presented by Mr. Case this evening, in its probably most recent and completed form. This statement showed that in certain given conditions where electricity was concerned, especially in electro-chemical reactions, you might have heat or electricity, and that the sum of the two measured the whole energy, so that if it were possible to prevent the formation of heat, you would get your quantum of energy all in the form of electricity; whereas, if it was not possible to do so, it would be in the form of heat. The experiments which Mr. Case has presented to us this evening demonstrate this to be true, and that we are dealing with a problem in which there is an innate tendency of energy to convert itself into heat, and if we can prevent the conversion of energy into heat we can retain it in the form of electrical energy. It is interesting from that standpoint, not only on account of the facts it places in our possession, but on account of the hints it throws out for future research. The society is greatly to be congratulated upon having had the pleasant opportunity of listening to a paper by Mr. Case. Mr. Case is one of those favored gentlemen who has the leisure, the talent and the means to devote himself to original research. I think it was eight years ago that he read a paper before the American Institute of Electrical Engineers on this subject. The work this evening shows that he has kept up with this work and that he has developed new and interesting principles. I think it is a fortunate thing that there are gentlemen who can devote themselves to these matters where, although there is no immediate prospect of remunerative results, there is a principle to develop, a scientific principle of value, which others may take up and apply to commercial uses of great value.

Professor Crocker: There were certain technical features brought out by Mr. Case which would bear a little more consideration. One was the use of the nickel crucible. He has found in his experiments just the same facts, I think, as Mr. Jacques has found, that iron exhibits rather a peculiar action, and I believe that Mr. Jacques found it necessary to treat the surfaces in some manner which has not been made public. Apparently, that difficulty has been entirely avoided by the use of nickel, and that you get a higher electro-motive force than is possible, even under the most favorable circumstances, with iron, and you are sure of it. It is constant and reliable. That, of course, from a practical standpoint, is a great step, and would seem to be one of the great difficulties experienced by Mr. Jacques in his work. That advantage of nickel over iron is easily explained, as indicated by Mr. Case. Caustic has very little action on nickel, and that is why nickel crucibles are employed—that they are exempt from action on them by caustics, and in this case, therefore, nickel is the ideal substance to employ. Now, iron, on the other hand, seems to be dissolved, more or less, when combined with the caustic, and produces not only a complicating action, but, probably, an opposing action. If the negative electrode is dissolved, as well as the positive, that would tend to set up a counter electro-motive force and interfere with the real action, so that the securing of an inert negative electrode is, in my opinion, an essential element with any successful battery. The use of nickel accomplishes that. It may be that all these peculiar phenomena noticed by Mr. Case are due simply to the action of the caustic on the iron under different circumstances, and I am inclined to think that is the case. The constancy of the nickel crucible is easily explained by this non-action, but we have a phenomenon discovered by Mr. Case, in this peculiar dropping off of the electro-motive force at a critical heat or temperature, about a red heat, which is not explained by any property of nickel which is known, or any phenomenon, chemical or physical, that is recognized. It may possibly be due to the driving off of the oxygen at that temperature from the electrolyte, but that would not explain the fact that the electro-motive force comes up again on cooling. It is absolutely an unknown and novel phenomenon, which is very interesting.

Mr. Case: I think the discovery of that is attributable, to a certain extent, to Mr. H. A. Prosser, who was working with me. We noticed the electro-motive force drop, and thought the circuit was broken. We investigated it and discovered the cause. I think it is entirely new.

Mr. Sacks: I would like to inquire regarding the amount of carbon consumption in the experimental cells; whether any experiment has been made as to the consumption of carbon for a certain fixed quantity of electrical output.

Mr. Case: I am sorry to say these experiments have not been made, but I have given directions to have it done this week or next. It never occurred to me that there was any particular use in doing it until I looked into this question a short time ago. Within the last few days I rather thought that question would be asked, and I am sorry I can not answer it now. I think the economy ought to be pretty high. I do not think there is much local action there. With certain kinds of carbon—with graphite, for instance—the local action is rapid. You put a piece of graphite into that peroxide of chlorine, and it combines it immediately and makes graphitic acid, and with carbon it makes $C O_2$, and does not seem to affect the carbon much unless the circuit is closed. I have had batteries, which have been in operation, lying about for a month or two months, and it does not seem to attack the carbon. You can not judge of it in an off-hand way, but that is my impression. I expect to know definitely within a week.

[To be concluded.]

*Paper by Willard A. Case before New York Electrical Society, February 24, 1897. (See page 104.)

ELECTRICITY FROM CARBON WITHOUT HEAT.

READ BEFORE THE NEW YORK ELECTRICAL SOCIETY, FEBRUARY 24, 1897, BY WILLARD E. CASE.

The subject has such possibilities, all within reasonable bounds, that I hardly know where to commence or finish. At present we have only crossed the boundary line of that field which, I am sure, will be productive of tremendous results. Thermo-electricity has attracted attention for a great many years past, and now and then we have heard of new inventions which led us to think that we were about to solve the problem.

As far back as 1801, Ritter noticed that a current was set up when the junctions of dissimilar metals were heated. And, following down to a later date, we find that some thermo-electric batteries were constructed which really produced electrical energy at small cost, and which have been, to some extent, found practicable. A thermo-cell was described by the speaker before the Royal Society in 1886, which I will now show you.

It consists of plates of tin and platinum, forming the electrodes, immersed in a solution of chromic chloride. When the cell is heated, the electrolyte becomes active. Chlorine, leaving the chromic chloride, temporarily combines with the tin and forms proto-chloride of tin. This chemical action generates electricity, and soon the tin is all converted into chloride, and the current ceases. When the cell is cooled, this temporary combination of the chlorine and tin is broken up, and the chlorine returns to chronium proto-chloride. The tin, being set free, falls as a metallic precipitate to the bottom of the cell in the form of crystals, ready to renew the operation. If this cell works between 80 degrees and 180 degrees Fahrenheit, or 538 degrees and 638 degrees absolute, the electro-motive force at the higher temperature is about .26 volt, but the possible efficiency is less than 16 per cent, owing to the operation of the second law of thermo-dynamics, which provides that, in the conversion of heat into work, the efficiency equals the higher temperature minus the lower temperature divided by the higher temperature reckoned from an absolute zero, the latter being minus 273 degrees centigrade—so that this cell is a heat engine—a reversible voltaic cell which passes through a complete cycle. It must be heated to operate, and cooled to regenerate itself. In this connection it may interest you to see in operation a more practical thermo-cell, which converts heat into electrical energy. This battery is said to consume two and one-half cubic feet of gas per hour and to generate 12½ watts.

In order to make the subject clear to those who are not familiar with it, let me say that all electricity, except that produced by water power or galvanic batteries, is obtained from carbon; that is to say, our electrical power of to-day is generated by the combustion of coal under the steam boiler, or by means of the gas engine, and, through the intermediary of engines and dynamo, this energy is converted into electricity. Now we all know that this conversion of the potential energy of coal into heat and then into work is a most wasteful process, owing to the intervention of the second law of thermo-dynamics above referred to; and how to overcome this law and to avoid this waste is the subject under discussion to-night. Practically, we only convert a small per cent of the potential energy of the coal into work, a large portion being wasted. It is not so much the inefficiency of the boilers or the steam engine or dynamo which converts this energy into electricity as it is the method adopted. When we burn coal under the boiler we transform the energy of that coal into heat energy, and the moment we do this we come in conflict; or, rather, become governed by the second law of thermo-dynamics. It is an inexorable law of nature that under the conditions in which we live a great waste must accompany the transformation of heat into any other form of energy. To illustrate: In hot-air and gas engines a cold-water jacket is usually employed, and to raising its temperature is diverted the larger share of the heat. In the thermo-pile the junctures must be cooled by a circulation of air or water, and in Edison's pyro-magnetic generator the iron tubes must be cooled by application of cold air.

In accordance with the second law of thermo-dynamics, the heat not lost, but which we can utilize in a given case, equals the difference between the high and low temperatures used, divided by the high temperature. Now, to express this more simply, there is heat of an expansive force in everything down to an absolute zero, but under ordinary conditions we can not economically use this heat in any machine below the average normal temperature in which we live; so, when once we set up molecular motion, called heat, we only use it above the normal temperature, up to that point to which we are limited by the destruction of matter, or, as we might say, to that point at which we burn out our boilers or melt our containing vessels. And this range is but a small fraction of the total range of the heat we have produced. Lodge has shown us that the energy in a pint of boiling water, if it could be all utilized, amounts to more than half a million foot-pounds, and if the water were quite cold and on the point of freezing, it would still contain energy of 350,000 foot-pounds of work, or one-sixth of a horse-power hour in every pint. Now, coal or zinc could be burned to heat this water to a boiling point, in which case only a part of the energy between that point and freezing could be utilized, which is a small portion of the total range between the boiling point and absolute zero. But either material can be oxidized in a galvanic battery without heat and waste, and electricity produced. If we burn the coal as Lodge has suggested, the highest temperature commonly available is that of the furnace; hence the heat should be supplied to the working substance in the cylinder at a furnace temperature. This condition is roughly satisfied in internal combustion engines, though they have many defects at present. This furnace temperature is about 2,000 degrees above absolute zero, or 1,500 degrees Fahrenheit, and if in this engine we could cool down to 600 degrees above zero, or 110 degrees Fahrenheit, we could have a possible efficiency of 70 per cent of the whole —2,000—600÷2,000=.70; that is, 70 per cent less the friction of the machine and the loss in the conversion into electrical energy, which would bring it down to something like a possible 50 or 60 per cent. The steam engine does not even approach this. Its theoretical efficiency at 300 pounds is 33 per cent, but in actual operation it is reduced to 25 per cent. Gas engines (internal combustion engines) come near this ideal. In fact, Professor Thurston states that a cannon, when being fired, has an efficiency of 50 per cent.*

Let it be understood that this is a law of nature; it is inevitable under the conditions in which we live. No cunningly devised furnace of feed-water heater, or cut-off, or triple-expansion apparatus, or pyro-generator can save this heat. The most that any of these devices can do is to save what would otherwise be wasted, over and above that which we must of necessity lose.

Now, the question which we naturally ask is: How are we to convert this potential energy of the carbon into electricity with the least loss? If the boiler, steam engine and dynamo are not available for our use economically, how shall we do it? We know that the voltaic battery does not act through the transformation of heat into electricity; it produces electrical energy direct. The zinc is oxidized and the potential energy of that zinc is converted directly into electrical energy without the production of heat. The second law of thermo-dynamics is thus avoided, as no heat appears. But the cost of this zinc and the chemicals employed to oxidize it are so expensive that we can not afford to use them. The cheapest materials which present themselves at present to our notice are coal or carbon and the oxygen of the air. And if we could convert the energy of the coal into electrical energy direct and cheaply, we could do away with our steam motors, in time, provided the apparatus was simple and practical. Now, there is no known reason why a cheap substance may not yet be found which will act on coal and develop electrical currents in place of heat; but the general tendency of late has been to discard this method and to attempt to find some stable electrolyte, or bath, which will act as a carrier of the oxygen of the air, conveying it to the carbon and oxidizing it as zinc is oxidized in a battery, producing electricity. This electrical energy would be the equivalent of the heat energy that would be developed by the combustion of the coal in the ordinary way.

Of course, in the construction of such a cell, we must be governed by the experience we have had with the galvanic battery, in which the elements of electromotive force, internal resistance, etc., are involved, and by which, consequently, the output of the cell is governed; such a cell must produce a large amount of energy, be simply and easily cleaned or recharged, in order to be practical. It must be as durable and as simple to use and handle as the steam boiler and dynamo are to-day.

It may be of interest to give you a comparative illustration of what the energy of coal does to-day, through the use of the steam engine, and what it would do provided we could oxidize it in a battery without heat. The average of large electric light plants requires four pounds of coal for every horse-power hour of electricity delivered from the dynamos to the line; that is to say, four large stations show a consumption of 4.2 pounds per horse-power hour; 49 stations, 4.6 per horse-power hour, and 32 small stations, 12 pounds per horse-power hour. Theoretically, .175 pound of coal will yield one horse-power hour, or, allowing for ash, .185 pound; and of zinc, one pound used in a battery produces one horse-power hour under a potential of two volts, including the loss in internal resistance. The cubes of these materials represent the weights required by each to produce one electrical horse-power hour.

Of course, the subject of electricity direct from carbon has been considered from many points of view. Some have attempted to obtain cheap electricity by using the oxygen of the air to oxidize various substances; others have attempted to oxidize coal with the oxygen of the air without heat, and others have attempted to oxidize coal by the oxygen of the air, with the application of external heat. The evolution of this subject is most interesting. We will, therefore, study the question from that point of view, and examine some of the most important batteries which have been constructed. We will do so chronologically. Of course, lack of time will compel me to avoid reference to many well conceived inventions.

Passing over the carbon-consuming cells of Jablochkoff, Bard, Crumm, Edison, Wright and Thompson, I will first describe the cell invented by C. S. Bradley in co-operation with Prof. F. B. Crocker, which was mentioned in the discussion of a paper read by the speaker on "Electricity From Carbon Without Heat," in 1888, before the American Institute of Electrical Engineers.

Mr. Bradley described fully the action of fused salts on coal, and stated that the oxygen of the air was absolutely necessary for the purpose of cheap oxidation, or, to use his own language, "The cell consisted of fused sodium manganate, and putting a blast of air through it, and by that means supplying it with oxygen and allowing it to act on the coal, which is put in another part of the vessel, a little over one volt was obtained."

The cell consists of an iron vessel two and one-half inches in diameter, and six inches deep, which is placed inside of a retort and heated by a gas flame to nearly a red heat. Electrolyte of the cell is caustic soda, to which peroxide of manganese is added, forming sodium manganese. In this cell is immersed the electrode of carbon, which acts as the positive pole.

The next cell to which I will ask your attention is that described by W. W. Jacques in *Harper's New Monthly Magazine* in December, 1896, which is another illustration of the same principle involved in the Bradley cell, with a few practical modifications. It, like the other cell, consists of an iron vessel, which is the negative electrode, containing fused caustic soda minus the peroxide of manganese, into which is plunged the positive coal or carbon. The oxygen is supplied by a blast of air, as in the cell before described, and an electro-motive force of about one volt is said to be obtained. The difference between these two cells, which I particularly desire you to notice—and the only practical difference between them—is the addition of peroxide of manganese to the bath of the Bradley cell; and although I have described them chronologically, I will first show the Jacques cell, and then, by simply adding peroxide of manganese to it, we will have the Bradley cell. We will then be enabled to get their comparative electro-motive force and current in the same cell. But I may say, in passing, that experience with these cells before you leads me to believe that the theory of their action is not by any means well understood. It is most uncertain and erratic, and seems to be more so before than after the addition of the manganese peroxide.

Its electro-motive force seems to depend upon its temperature. If water is present when the caustic soda is first used, a reverse current becomes manifest. When air is blown through the electrolyte, the electro-motive force is increased. Sometimes only .3 of a volt is obtained; sometimes about one and one-half volt. But the greatest amount of current is apparent when the carbon is

* *Science*, October 3, 1891.

immersed in the bath, and, curious to say, the highest electro-motive force is obtained when the carbon rod is drawn up along the side surface of the vessel and out of the bath. If the immersed carbon rod is brought in contact with the cold exterior surface of the vessel, no electro-motive force is observed.

Many other peculiar actions will be noticed if the carbon rod is replaced by an iron one.

With this form of cell it is claimed that as high as 85 per cent of the energy of the carbon consumed is converted into electrical energy. The following results of tests of the Jacques cell, taken from the article referred to and from the *Engineering Magazine* of July, 1896, may be of interest:

Electricity obtained from one pound of coal (of which 0.4 pound was consumed in the pots and 0.6 was burned on the grate) equaled 1,336 watt hours, or 32 per cent of that theoretically obtainable.

Another cell, reported in the public prints to have been built and operated by Jacques, consisted of 100 iron cells one and one-half inch in diameter and 12 inches deep, which gave an electro-motive force of about 90 volts and 16 amperes, supplying 30 16-candle-power incandescent lamps for a little over 18 hours. In this experiment it is said that about eight pounds of carbon were consumed in the cells. This, it was stated, gave an efficiency of over 90 per cent, which, of course, did not include the power to operate the air-pump and the coal consumed in heating the cells. But my experience with the cells before you leads me to doubt the correctness of these computations.

It has been suggested that carbon-consuming batteries would be too bulky and occupy too much space, as compared with that occupied by the present central station for a given output. I find, however, that the Edison station at Duane street has a capacity of 28,000 electric horse-power. The cubical capacity of the building is, in round numbers, 900,000 cubic feet. The same building, crowded with Jacques cells, assuming that they could perform the work claimed for them, and leaving aside the question of the difficulty of their operation, properly distributed, would have an output of 60,000 horse-power. This estimate is necessarily theoretical and based entirely upon statements made by Mr. Jacques; namely, that a furnace containing cells occupying a cubical space of 600 feet have a capacity of 40 electrical horse-power. You will thus see that this ratio is in the proportion of 28 to 60 in favor of the battery.

It has been stated that the electro-motive force of the carbon-consuming cells is so low that they would be of no practical value. I think our experience with the storage battery in central stations refutes this idea; at least, for potentials up to 250 volts, and by means of rotary transformers, the current can, if necessary, be converted into any form and pressure.

These cells, if correct in theory, can be heated without infringing on the second law of thermo-dynamics, as the law does not apply, so long as the oxidation of the carbon itself does not produce but electricity.

For, as we have said, there is heat in the electrolytes and all matter down to an absolute zero, and the electrolyte in the practical operation of these cells is simply heated to permit the chemical affinities acting.

We are governed here, as elsewhere, by the laws of evolution, and I think that this question will be solved only through many attempts and many failures. I believe that we must look at this subject from a different point. In the first place, can we not learn a lesson from nature? We certainly have a most wonderful example of the conversion of potential energy of carbon directly into work in the animal economy, which is developed at the expense of the oxidation of the material supplied by the food, with an efficiency twice as economical as in the case of the steam engine. One-fifth of the potential energy is converted into work; four-fifths is converted into heat. But we must remember that the human body must be able to exist in the arctic regions as well as in the tropics; that the engine-room must always be kept warm, and to insure this average in all parts of the earth and under all conditions, the four-fifths of what apparently is waste energy is necessary to maintain the race.

A day's work of muscular toil is laid down by the authorities at about 1,084,950 foot-pounds. The normal daily expenditure in heat can not be so readily determined; it is estimated at 6,148,000 foot-pounds; that is, between one-fifth and one-sixth of the potential energy of the food is expended as mechanical labor; the remaining four-fifths or five-sixths leaves the body in the form of heat. Of course, eventually the work goes into heat and is dissipated.

In the human economy the oxygen of the air is taken up by the blood in the lungs. It is carried through the arteries and attacks the tissues, giving up its oxygen and so oxidizing them and thus producing heat; and when the work is done, the equivalent of the heat disappears as work, and when the work is not done, the temperature rises, perspiration and evaporation takes place, and the temperature is kept at its normal condition through this safety valve. In other words, expressed electrically, there is local action as in a battery. I am aware that the question of the cause of muscular contraction is in dispute, but is generally admitted that the muscular force must be derived from mechanical energy.*

Observing, in the first place, that nature prepares the food which it consumes to perform its functions, the food is taken into the stomach and digested. A great part of it is useless; the best part is selected and is transformed into a condition in which it can be easily oxidized at a low temperature, the blood acting as the carrier of the oxygen. Does this not give us a hint that we should follow this course likewise and prepare the material for our carbon-consuming batteries? The oxygen of the air we always have with us; so have we many carriers of oxygen, but an attempt, so far as I know, has not yet been made along this line which I suggest, except that illuminating and other gases have been used.

A cell which I will soon show you is one described by me in a paper read before the Society of Electrical Engineers in 1887. It consists of two electrodes, one of carbon surrounded by powdered carbon in a porous cup, and one of platinum, both being immersed in an electrolyte of sulphuric acid in a glass jar about one inch in diameter and six inches in height. Into this electrolyte, when we introduce chlorate of potash, we form peroxide of chlorine, which is a very unstable gas, and decomposes in the presence of carbon. Its oxygen attacking the carbon oxidizes it without heat, the chlorine being set free at the platinum pole. Electricity is generated with an electro-motive force of 1.3 volt, varying with the amount of oxidizing agent present and with the kind of carbon used; or, we can place these two electrodes in a vessel containing water, generating this gas outside the cell, and pass it over into the cell containing the electrodes, in which case the cell will operate the same as before, its internal resistance being regulated by the amount of sulphuric acid we may wish to add to the water.

You will notice that, when the electrodes are immersed in the sulphuric acid, only a slight electro-motive force is indicated, due to the combination; on the addition of chlorate of potash the electro-motive force is about 1.3 volt per cell and the current about .4 of an ampere.

To show you that the action is strong and the oxidation of carbon rapid, I will connect the cell with this little electric bell, which will give you an idea of its strength.

We have been taught to believe that the electro-motive force, due to the oxidation of carbon, is about 1.05 volt. This value has been arrived at by assuming Andrews's determination that the oxidation of one pound of carbon to CO_2 equals 14,544 board of trade units, or that one gramme equals 24,944 foot-pounds. This determination was only approximate, and, further, it was a determination made at a very high temperature. Now, you have seen that the oxidation of carbon in this cell without heat has produced one and three-tenth volts, and would produce even more, if we chose to concentrate the peroxide of chlorine present, which is rather a dangerous operation, as the gas is an explosive one under some conditions. So it would apparently appear that there are more foot-pounds of energy in a pound of carbon than shown by Andrews, unless the additional energy in this instance comes from the peroxide of chlorine.

It might be thought that the high electro-motive force obtained in this cell is due to the action of the nascent chlorine on the platinum, but careful measurements have determined the contrary.

We have, therefore, a cell in which carbon is oxidized without the application of heat and at normal temperatures; a cell in which oxygen in unstable composition is readily given up to the carbon, and the product of the oxidation is carbonic acid gas, as proved by analysis. I think we have, therefore, the right to assume that a large per cent of the potential energy of the carbon is converted into electrical energy. The point I wish to make in this connection is: We have in the cell conditions which are analogous to those taking place in the human system, at least to the extent that carbon is, and can be, oxidized at the normal temperatures in which we live, and its potential energy converted into electricity.

We have in the blood of the human economy a carrier of oxygen, called haemoglobin. It absorbs its oxygen through the lungs, each gramme taking up 1.34 C. C. M. of oxygen. This oxygen is in such unstable condition that it can be extracted from the blood by means of a vacuum and by means of a most reducing agent. It has the power to oxidize carbon and hydro-carbons as the body provides them, without external heat.

We have in this test tube, water containing haemoglobin in solution. You will see by transmitted light it is of the color of arterial blood, as it is fully oxidized, and when a reducing agent is added to it, and the air excluded, you will see that it becomes the color of veinous blood, and when the air is again admitted it takes up the oxygen and becomes arterial in color. This game can be played, of give and take, and oxidizing and de-oxidizing, as many times as we like. Even carbon reduces it and gives it electro-motive force.

What I want to express to you is this: In this battery which I have just shown you, carbon is completely oxidized at normal temperature by oxygen, which is held in loose combination. So it is done in the human body, and we know that to be a very efficient machine. Therefore I see no reason to think that it is necessary for us to use high temperatures. Keep without the second law of thermo-dynamics. Search for a suitable carrier of oxygen, or some cheap source of oxygen supply and hydrogen or carbon, or a carbon compound easily oxidized.

Does it not seem logical that by following along this line, and by preparing material to be consumed as nature does in the human body, we may yet be able to reach the desired end with economy? Is it not probable, judging from human experience, that within the wide range of materials some cheap means can be found? I believe it is. Like all good things in nature, it will come through many trials and failures. The struggle for existence will perfect it, but there is no known law which indicates that we are dealing with the impossible.

In closing, I beg to make my grateful acknowledgment to Mr. Prosser for his valuable assistance, and to thank the members of this society for their courteous attention.

* Proceedings of Royal Society, March 14, 1895.

Telephone News from Chester, S. C.

To the Editor of Electrical Review:

A week ago Messrs. C. E. Bloom and T. M. Webb, representing the Columbia Phonograph Company, of Washington, D. C., were in our town, and to make a test of their instruments, and also our telephones (which work on ground circuit), we connected eight subscribers, making a circuit of 14 miles, and played several pieces for them, all of which were distinctly heard.

The telephone company of this place now has 97 subscribers, with a capacity for 100, and is now building a new two-story fireproof building, and will install a board of the latest style and a capacity for 200 subscribers, wired for metallic circuit. Will say in behalf of the company and to the interest of other small towns (for this one has only a population of 5,000), that the company opened business three years ago with 11 subscribers, and has never lost a single one.

Yours respectfully,

J. E. Pryor,

Sub-Manager Chester Telephone Company.

Chester, S. C., February 20.

The Westboro, Mass., Electric Light and Power Company, which was incorporated under State of Maine laws in 1888, has now been chartered under Massachusetts laws, with a paid-up capital of $25,000, and is known as the Westboro Gas and Electric Company. The following are the new officers: President, Geo. O. Brigham; treasurer, W. A. Reed. Directors: Geo. O. Brigham, G. L. Smith, F. V. Bartlett, T. T. Robinson, R. D. Smith, E. E. Dunlap, O. K. Newton; superintendent, R. D. Smith.

Mr. F. B. Perkins, treasurer of the Walker company, is at the Waldorf Hotel, New York.

LENARD RAYS, DISCHARGING POWER, GREAT VARIETY AND MAGNETIC DEFLECTION IN HYDROGEN.

BY EDWARD P. THOMPSON.

The contents of a communication from Dr. Philip Lenard, of Heidelberg, may be of interest as shedding some light on the relations between X-rays and external cathode rays. The occasion of the open letter is my treatment of the external radiations from a discharge tube (Crookes tube), and especially my discussion of his own researches, which were originally published in several foreign proceedings of societies, and in foreign languages, some of them being published by *Berlin Akad.*, January 15, 1893; *Wied. Ann.*, January, 1894, LVI, p. 225; *Wied. Ann.*, vol. LI, p. 259, and papers and articles of 1895 and 1896.

Translations of these and other papers, discussions of Lenard's results by other investigators and Lenard's latest theories were considered in my own language, under about 20 headings, in the book, "Roentgen Rays and Phenomena of the Anode and Cathode," setting forth in a classified manner the various facts, principles and theories relating to external cathode (or Lenard) rays.

Dr. Lenard, in stating that "we agree in all you have said on my experiments in the text of your book", discloses succinctly his present valued opinions on three points in this English letter. One of his remarks seems to indicate that he does not agree in all points with Professor Roentgen.

In Section 77, I stated:

"A remarkable occurrence was the accomplishment of the discharge at a much greater distance than that at which phosphorescence was exhibited. See also experiments of Roentgen, who suggested that Lenard had to do with X-rays in his experiment, but thought they were cathode rays. The maximum distance for the discharge was 30 centimetres, measured normally to the aluminum window. He (Lenard) admitted that the experiment was not carried far enough to know whether the effect was due to the action of the cathode rays upon the surrounding air or upon the plate."

The above related experiments were performed, it should be remembered, before Roentgen's discoveries.

Dr. Lenard now says, as stated in the letter referred to:

"I do not think the electric (discharging) actions at a great distance from the window of my apparatus due to Roentgen rays, because I have convinced myself in the meantime that these latter rays are only present in minute traces, and that there is another explanation of the effect observed. The air is made conducting by the deflectible cathode rays near the window, and afterwards extends to parts further apart, whilst retaining its conducting property."

As to the next point, I went so far in the matter of the variety of rays as to head one paragraph "*Cathode Rays of Various Kinds are Variably Diffused.*" As intimated in his early papers, Lenard still reasons in the present open letter that there are "rays of an unbroken series of an infinitely great number of different rays, varying gradually in properties".

Lenard has generally been misunderstood regarding the magnetic deflection of cathode rays outside of the discharge tube. Dr. Lenard makes this point very clear. The book states, on page 66:

"The author could not find in Lenard's papers any positive or negative proofs that he had actually deflected the external cathode rays by a magnet while passing through air or gas *at ordinary pressures.** * * *" Dr. Lodge, who briefly reviewed Lenard's experiments, expressed the same opinion. (See *The Electrician*, London, January 31, 1896, p. 439.) Dr. Lenard modifies this by saying, "I have effected the deflection in hydrogen. The deflection is not visible in air of ordinary pressure, only because such air is too turbid to show any distinct rays at all which could be distinctly observed at sufficient length to show deflectibility."

Regarding the book in general, he very graciously condescends to compliment and encourage an American author by saying, "I find it very useful for getting information as to the very extended recent literature on the subject;" and he exhibits the usual great man's modesty by referring to his world-wide known and wonderful discoveries, thus: "You have given much space to my own little share in the work."

Time of X-Ray Exposures.

TO THE EDITOR OF ELECTRICAL REVIEW:

In your issue of February 17 I note two letters, entitled "Time of Exposure in X-Ray Work" and "X-Ray Apparatus," which refer to statements made in the recent Franklin Institute paper by Mr. Sayen* and myself, just abstracted in your columns, and which require reply.

Regarding time of exposure, your correspondent, Dr. Monell, states that "five minutes, a good tube and a good operator will suffice for the trunk"; also, that he obtained "a negative of metallic objects through the trunk, etc., * * * * in five minutes". In our paper I stated that as a regular thing 15 to 30 minutes is required for a trunk picture "*showing complete detail of osseous structure involved*". To obtain metallic objects *through* the body is generally considerably easier than to get the same object *in* the body, largely because, in the former case, the object is *on* the plate, so that the shadow is compact and sharp. I should consider five minutes rather a *long* exposure for a bullet *through* the body (bullet being on plate side) with a good tube, apparatus and operator. But *detail* of bony structure, etc., is a very different matter, and to the best of my knowledge can not be regularly secured in times less than I stated. That there may be *occasional* cases of exposures greatly less than I have given, producing fine results, I do not doubt. One case has recently been recalled to my attention, though it had slipped my mind at the time my paper was written. It is that of a trunk picture taken by Dr. A. W. Goodspeed, of the University of Pennsylvania, only a few weeks after the original Roentgen announcement was made. The tube was the orthodox pear-shaped "aluminum cross" tube of the Crookes series—distance from plate something like 20 inches, and time of exposure *one minute*. The result was almost perfect, the bony structure being very completely and shapely detailed. But Dr. Goodspeed has never been able to do anything like this again, either with the same or other tubes, and has no explanation to offer for the wonderfully good result on this occasion. Probably "there are others."

Regarding Mr. Renny's letter, I think probably we both have the same views as to low and high-exhaustion tubes. The use of such terms in such a connection is purely relative. If we get the exhaustion *too* high, we *do* wipe out almost everything; if *too low*, everything casts equal shadows. Speaking generally, we must use low tubes for hand, arm and leg, from knee down; high tubes for body, hip joint, etc.

I should be glad to know how Mr. Renny's Tesla coil, "having none of the disadvantages which he says such coils must necessarily have", is made. The disadvantages of the Tesla coil, as compared with the induction coil, and as given by me, were:

1. Tesla coil has at least twice the number of parts—more complex.

2. Tesla coil uses oil—not so cleanly.

3. Tesla coil requires an operating spark gap—noisy.

4. Tesla coil produces alternating currents—we get either *two* foci and consequent blurring, *or* reversal of the tubes and consequent blackening.

1 and 3 *must* be true, since they embody the very definition of the Tesla coil; 2 is not necessarily true, but happens to be actually true, according to the practice of the majority of manufacturers of Tesla apparatus; 4 is true in all the tubes I know of, or, at least, recall at present. I would not say that a tube might not be constructed, of which this objection would not be true, but I know of no such tube now made.

Whether or not the Tesla coil or induction coil puts the larger strain upon the tube is a matter of opinion, and I so implied in my paper.

ELMER G. WILLYOUNG.

Philadelphia, February 20.

* X-Ray Apparatus and Methods, ELECTRICAL REVIEW, January 27, February 3 and February 10, 1897.

The stockholders of the Canton-Massillon, Ohio, Electric Railway Company at their annual meeting elected the following officers: J. N. McClymonds, J. W. Underhill, C. A. Gates, C. M. Russell, H. C. Fogle, R. A. Miller, W. A. Lynch.

ELECTRIC RAILWAY NOTES.

The operation of the street railway system at Keokuk, Iowa, has been discontinued, owing, as the owner alleges, to a lack of patronage on the part of the Keokuk public.

The Second Avenue Traction Company, of Pittsburgh, Pa., has ordered 40 Summer cars for its leased line, the North Side Traction Company, which in substance is the Pleasant Valley system. Preliminary plans have been prepared for a $150,000 power plant, to be erected in Allegheny, capable of generating 3,000 horse-power.

Stockholders of the City Passenger Railway Company, of Baltimore, Md., at a special meeting authorized the issuance of $500,000 certificates of indebtedness. Money obtained from their sale will be used in paying off the company's floating debt, which was created in making betterments, and will provide funds for proposed improvements, including the equipment of the Blue line with electricity.

The electrical railway enterprises now seeking franchises from the New Hampshire Legislature are backed by an association of prominent men in that and other States, with C. H. Busiel, ex-Governor of the State and ex-director of the Concord & Montreal road, as its president. The project as outlined in the bills contemplates an electric line from Massachusetts to Canada.

At the annual meeting of the Fort Wayne, Ind., & Belle Isle Street Railway Company the following directors were elected: E. H. Butler, S. Schloss, D. M. Ferry, David Whitney, Jr., N. W. Goodwin, Charles E. Kanter and David E. Heineman. These directors then met and elected E. H. Butler, president; S. Schloss, vice-president; D. Whitney, Jr., treasurer, and N. W. Goodwin, secretary.

An interesting case is now on trial in Pittsburgh. Street-car companies generally have a sign up that change to the amount of $2 will be made by the conductor. A lady boarded a street car in Pittsburgh, and when called upon by the conductor, tendered a $5 bill, the smallest amount she had. The conductor refused to change the bill, and, as she had nothing smaller, put her off the car. She has sued the company for $500 damages. The defense of the company is that $2 is the limit of change under an unwritten universal law in the street-car world.

The East Penn, Pa., Traction Company, which was recently incorporated, has elected the following officers and directors: A. S. Cadwallader, Yardley, president; Walter R. Johnson, Hulmeville, vice-president; J. Uhle Bethell, Philadelphia, secretary, and E. W. Meloney, Yardley, assistant general manager. Directors: John T. Fish, Fallsington; T. Howard Atkinson, Buckingham; W. R. Andrews, George D. Armstrong, Robert E. Pleme, Dr. S. Edmund Long, Walter Brown, William C. Wilson, David Hanley Stone and Theodore T. Hansen, Philadelphia.

Improved Construction of the Alternating-Current Ceiling Fan.

The "Tuerk" alternating fan sprung into such universal demand last year that, before the Summer season was over, the large factory of the manufacturers, the Hunter Fan and Motor Company, Fulton, N. Y., was taxed to the utmost to produce fast enough.

For the '97 type a simple switching device has been added which greatly facilitates the control of the fan. The oil chambers have been enlarged so that one supply of oil carries the mechanism through the season, or through several seasons, and a number of minor improvements in the detail of construction have been made which will increase the popularity of this now essential apparatus.

The ingenious mechanical arrangement for reducing the speed and transmitting the power of the electric motor is shown in Fig. 2. The switching device, which has been added in the type made this year, is operated in connection with the blade adjuster. The upper wheel operates the switch and the lower wheel adjusts the blade, which may be done while in motion. In the new type, also, the upper armature bearing is provided with larger oil chambers, so as to eliminate a possibility of the necessity of oiling for at least a season, and the journals are all made of hardened tool steel.

The mechanism includes a motor, a shaft with beveled transmitter wheel, a case inclosing the motor and carrying the fan arms and beveled intermediate wheels (faced with leather), engaging with the pulley interiorly and exteriorly with the inner face of the case, whereby the case is rotated around the motor, but at a much slower speed. In this construction the transmitting wheels are mounted in swinging frames hinged to the stationary support which carries the motor case, and the weight of the fans and outer case is utilized to produce and maintain the frictional contact of the wheels, because the case and fans are supported by wheels, so that the friction is always the same, and any wear upon either pulley, wheels or case is automatically taken up, and the fan is thus always at a fixed ratio to that of the motor. It will readily be seen that the friction on all the journals is reduced to a minimum, there being no cramping strain, all shafts being perfectly balanced and stepped with a single steel ball supported by a hardened steel screw.

Means are provided for circulating the oil, and all shafts being set vertically the oil can not waste. Means are also provided for carrying the motor case in a vertical position in the outer revolving case by providing the case with a tubular stem, in which the armature shaft is journaled and the outer case is provided with a tubular shank, which revolves around the stem while the armature shaft revolves within it. The letters B, C, D, D, in Fig. 2, show the oil reservoirs.

These fans operate on any of the standard alternating systems and at different voltages, ranging from 50 to 120 volts. The actual energy consumed by these motors is from 120 to 140 watts, depending wholly upon the angle of the blades, which are adjustable and may be set at any angle desired. They are finished in bower barff, bronze, ivory and gold, full nickel and polished cast brass.

FIG. 1.—1897 TYPE OF TUERK ALTERNATING-CURRENT CEILING FAN, SHOWING NEW SWITCHING DEVICE.

The selling agency for the Hunter Fan and Motor Company for the entire East will be under the management of E. B. Latham & Company, 136 Liberty Street, New York.

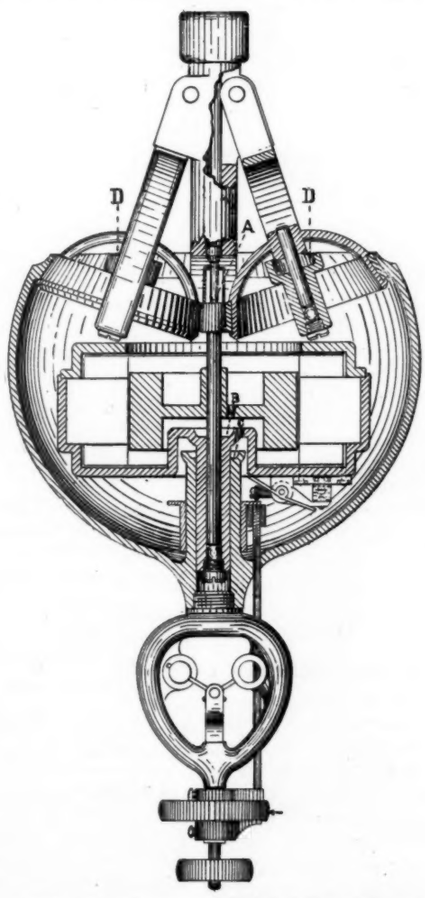

FIG. 2.—MECHANICAL CONSTRUCTION OF THE TUERK ALTERNATING-CURRENT CEILING FAN, SHOWING OPERATION OF SWITCH.

It is reported that the Card Electric Company will remove its plant from Mansfield to Toledo, Ohio.

A Washington's Birthday Souvenir.

The American Electrical Works, Providence, R. I., recently sent to their friends and customers a novel and attractive souvenir of Washington's Birthday. A part of it consisted of an excellent steel engraving of the Father of His Country. On a separate sheet was a diagrammatic history of the famous cherry tree episode, followed by these words:

"We present herewith a steel plate portrait of the 'Father of our Country', whose early history is given above. You will please accept the same with our compliments, and as you describe its magnificence to your acquaintances, please do not forget to mention the donors, and kindly allude to them as the largest makers of the best bare and insulated electric wires and cables."

A Decision on an Electric Heater Switch.

On February 15, in the United States Circuit Court, State of New York, at Utica, Judge Coxe handed down a decision in favor of the American Electric Heating Corporation, of Boston, as against the Consolidated Car Heating Company, of Albany. The title of the suit was, "The Dewey Electric Heating Company vs. The Albany Railway Company." The former is owned by the American Electric Heating Corporation and the latter are users of the Consolidated Car Company's heaters. The object of the suit was to prevent the use of a switch, in combination with electric heaters, for varying the amount of heat in cars, as covered by patent No. 464,247, granted to Mark W. Dewey, December 1, 1891, for "improvement in electric heating apparatus." In granting the decree Judge Coxe says: "The invention consists in combining any desired number of distinct sections, each complete in itself, adapted to be connected with the supply conductors in series, in multiple arc, or in multiple series with a switch for controlling these connections and an indicator operated by the movement of the switch to show how the connections stand. * * * * Matters relating merely to form and location are not the essence of the invention. * * * * The defendants' combination operates in substantially the same manner and accomplishes the same result as the combination of the claim."

This is rather an important victory for the American Electric Heating Corporation, for it affects all the installations heretofore made by the Consolidated Car Heating Company, as well as those of others using a combination switch to vary the heat. It is further claimed that this decision stops the use of combinations that have been in vogue in the past by others than the American company, making it necessary to have a group of switches if a number of heats are desired.

At a meeting of the directors of the Holley, N. Y., Electric Company the following officers were elected for the ensuing year: President, L. J. Hill; vice-president, Edwin Bliss; treasurer, George N. Bowman; secretary and manager, Henry J. Buell. The annual report of the secretary shows that the total receipts from commercial and street lights and renewals were $3,656.16; the operating expenses and fixed charges for the year were $2,772.60, leaving a net profit of $883.56. There was disbursed during the year, for extension of plant and improvements, $541.27. The total cost of the plant is $13,869.34. During the year $500 of the bonds of the company was paid and cancelled.

The Hilles & Jones Company, of Wilmington, Del., have issued a very beautiful pamphlet, illustrating a number of their new and special machine tools.

ADVANCE INFORMATION

Electric Light and Power.

MILFORD, PA.—The Milford Electric Light and Power Company has been incorporated, with a capital stock of $10,000.

HATBORO, PA.—Hatboro Electric Light Company has been incorporated, with a capital stock of $20,000.

CHICOPEE FALLS, MASS. — The Chicopee Gas Light Company; Gas and Electric Light Commissioners approved of an issue of capital stock amounting to $135,000.

SOUTH PARIS, ME.—South Paris Board of Trade may be addressed concerning electric light plant.

PORT HURON, MICH.—The City Electric Railway will erect a plant of its own.

NEWTON, MASS.—City Clerk may give information concerning proposed erection of electric light plant.

DE VALLS BLUFF, ARK.—An electric light plant is to be established immediately.

CORDELE, GA.—The Citizens' Electric Light Company have ordered two large dynamos, with a view of lighting this city with arc lights and giving the commercial lines better service.

DEPEW, N. Y.—The Depew & Lancaster Light, Power and Conduit Company has been incorporated; capital, $20,000. Directors, John N. Scatcherd, J. L. Hunsicker, George R. Teller, Wm. B. Rogers and Martin Carey, all of Buffalo.

NEW YORK, N. Y.—New Power and Light Company has been incorporated, with a capital of $100,000. The directors are B. F. De Freece, L. C. Hunt and M. J. Katz, of New York.

ROCHESTER, N. H.—The Consolidated Light and Power Company has been changed to the United Gas and Electric Company. Mr. Wallace, president.

JACKSON, TENN. — An electric light plant is to be established here.

ONALASKA, WIS.—This city is considering putting in a plant and lighting the city with electricity.

CLARKSVILLE, TENN.—The Clarksville Electric Light Company's plant has been purchased by Thomas Bourne, who will operate same.

SWEETWATER, TENN.—The City Clerk may be addressed for information concerning the establishment of an electric light plant.

RANDOLPH, VT.—Steps are being taken to establish an electric light plant.

SUFFIELD, MASS.—The Electric Light Company is preparing to establish an electric light plant.

WATERVLIET, N. Y.—City Clerk may give information concerning improvement of electric light plant.

ST. LOUIS, MO.—Robert E. McMath, President Board of Public Improvements, can give information concerning lighting streets of city with incandescent and arc electric lights.

GREENFIELD, TENN.—Steps are being taken to establish an electric light plant.

JONESBORO, TENN.—Town Clerk may be addressed for information concerning establishment of an electric light plant.

DEMOPOLIS, ALA.—The Demopolis Electric Light and Power Company will establish an electric light plant of 25 arc lights and 600 incandescent.

OWENSVILLE, IND.—Town Clerk may be addressed for information concerning construction of an electric light plant.

SHARPSVILLE, PA.—The Sharpsville Electric Light Company has transferred its plant and charter to Robinson Brothers, who have purchased the entire establishment. The officers of the new organization are as follows: President, S. A. Robinson; secretary, H. W. Robinson; treasurer, W. V. Robinson; trustee, C. S. Robinson.

TOWSON, MD.—The Pikesville, Reisterstown & Glyndon Electric Company, of Baltimore County, has been incorporated, with a capital stock of $25,000. The incorporators are Edmund T. Mudge, Henry L. Naylor, Arthur A. Rich, Frank Della Torre and Randolph Barton, Jr. The company proposes to furnish both street and house lighting.

AKRON, OHIO—The County Commissioners recently awarded to Pierre J. Boucher, for the Akron Street Railway and Illuminating Company, a contract for wiring and lighting the county infirmary with electricity.

CHICAGO, ILL.—Irving Park Electric Light and Improvement Company has been incorporated; capital stock, $10,000; to operate an electric light plant. Incorporators, Henry G. Zander, William A. Gray and George Mamerow.

BODIE, CAL.—It is expected that next Summer a powerful electric plant will be erected on the river a few miles below Bridgeport, Mono County, to furnish power to the newly consolidated mines at this place.

SAN BERNARDINO, CAL.—A corporation to be known as the Southern California Power Company has been organized, with a capital stock of $1,000,000. The principal stockholders are Henry Fisher, of Pittsburgh, and H. H. Sinclair, president and manager of the Redland Electric Light and Power Company. The purpose is to develop power from the Santa Anna River, to be transmitted 75 miles to Los Angeles, running through San Bernardino, Pomona, Ontario and Pasadena.

PAULSBORO, N. J.—There is a proposition to have the town lighted by electricity; also to establish an electric road from here to the steamboat landing at Billingsport.

TONAWANDA, N. Y.—Tonawanda Lighting & Power Company has been incorporated; capital, $150,000. Directors, William B. Rankine, of New York; George W. Davenport, of Boston, and Frank S. Smith, of Angelica.

New Electric Railways.

NEW YORK, N. Y.—The Rockaway Electric Railway Company has been incorporated by Remington Vernon, Joseph McLean, George F. Keller, Cornelius Connelly, Theodore Bernard and others, to construct a double-track street surface railroad about four miles in length. Capital stock, $250,000.

PELHAM, N. H.—A bill is before the New Hampshire Legislature to charter an electric railroad from the State line in Dracut to Derry, N. H.

BROCKTON, MASS. — An electric road will probably be constructed from this city to East Bridgewater.

KENT, OHIO—The Kent council has under consideration an application from John P. Cowing and Valentine Morris, of Cleveland, for a street railway franchise on East Main street. They want to connect Kent, Ravenna and Lake Brady.

GARDENVILLE, N. Y.—The Buffalo, Gardenville & Ebenezer Electric Railway Company has been granted by the town of West Seneca an additional franchise for the extension of its road to this place and Ebenezer.

SPOKANE, WASH.—The Lidgerwood Electric Street Railway contemplates making a number of improvements this Spring. David Glass is president of the company.

PARKERSBURGH, W. VA.—An application for franchise to build a belt line railroad between this city and Williamstown and Waverly has been asked for by F. J. Cutter, of Marietta.

COLUMBUS, OHIO—The Dayton & Western Traction Company has been incorporated by Charles L. Kurtz, Dr. J. E. Lowes, Robert M. Nevin, Oscar G. Sheppard and J. T. Feight, to build an electric road from Dayton west to the State line. Capital stock, $400,000.

GARDNER, MASS.—The Gardner, Westminster & Fitchburg Electric Railway will probably be constructed in the Spring.

XENIA, OHIO—An electric road will probably be constructed from Wilmington to Dayton, by way of Xenia, a distance of about 33 miles.

JERSEY CITY, N. J.—The Consolidated Traction Company in Jersey City contemplates building an elevated road over the surface trolley road, to run from the junction of Communipaw avenue and Grand street, Jersey City, to the ferry.

LAWRENCE, MASS.—A franchise has been granted by the selectmen of Andover to the Lawrence & Reading Street Railway Company, giving permission to lay tracks through the town. Work on the road will be commenced as soon as possible. Lawrence will be connected with Reading by electrics.

NEWTON, MASS.—A franchise has been granted to the Newton Street Railway Company to lay tracks and operate cars by electricity on Pleasant and Bridge streets.

New Telephone and Telegraph Companies.

ALTON, ILL.—S. F. Connor is organizing a telephone exchange, which promises cheaper rates than those given by the present telephone company. Already 150 names have been secured, and it is intended to open the new exchange just as soon as 250 names are secured.

CUERO, TEX.—The Gulf Coast Telephone Company has been incorporated, with a capital stock of $10,000.

CONWAY, ARK.—A telephone line is being put in from this place to Green Brier by the way of Wooster.

HILLSBORO, TEX.—A plan is on foot by Hon. Ed W. Bounds, of this city, W. B. Bounds, of Hubbard, and others, to establish a telephone line from here to Hubbard, thence to Armor.

NEW YORK, N. Y.—The City and Suburban Telephone Company, with its principal office at No. 203 Broadway, has been incorporated. The company is to operate between New York, Albany, Brooklyn, Buffalo, Schenectady, Amsterdam, Fonda, Fort Plain, Little Falls, Utica, Rome, Ogdensburg, Syracuse, Watertown, Oswego, Monticello, Binghamton, Auburn, Elmira, Geneva, Corning, Rochester, Olean, Batavia, Lockport and various smaller cities and towns throughout the State. The capital stock is $100,000, and the directors are Alfred H. Teller, Charles R. Minshull, Charles A. Teller and G. Rowland Munroe, of Brooklyn; Henry B. Oakman and Samuel Bear, of New York, and Charles E. Tompkins, of Jersey City.

PLATTSBURG, MO.—The Plattsburg telephone system has been sold to Dr. Fitzhugh Frost, of this place.

New Manufacturing Companies.

BUFFALO, N. Y.—The Proctor-Raymond Manufacturing Company has been incorporated by Charles H. Proctor, Nelson H. Raymond and H. H. Fink, to manufacture electrical and hardware supplies and appliances. Capital stock, $30,000.

PLYMOUTH, MASS.—Edes Manufacturing Company, manufacturers of zinc plates for small electric batteries; plant destroyed by fire at a loss of $30,000, on which there is $25,000 insurance.

Increase of Capital.

HUNTSVILLE, ALA.—The Huntsville & Monte Sano Improvement Company has obtained privilege to increase its capital stock to $1,000,000, and to construct gas and electric plants, etc.

The Bell Telephone Company, of Ottawa, Ont., have appealed to the Dominion Government to be released from the operation of an act of Parliament, which restricts their rates. They point out that they have been losing money in Montreal, Toronto and Ottawa, and want power to increase their rates. Their appeal has been taken into consideration by the government.

Kindred.... ...Interests

Taber & Mayer, 185 Franklin street, Boston, Mass., is now the name of the firm formerly known as Murdock & Taber, manufacturers of telephone apparatus.

The Standard Air-Brake Company, of New York city, has secured the services of Mr. Herbert B. Taylor, at present with the Consolidated Traction Company as chief assistant in the electrical department to Mr. F. Uberlacher. Mr. Taylor has handed in his resignation, and entered the service of the Standard Air-Brake Company on March 1.

The Proctor & Collier Company, Cincinnati, have opened an office in the Marquette Building, Chicago, with Mr. John Lee Mahin as manager. The Proctor & Collier company have worked the field of advertising in and about Cincinnati so well during the past 12 years that they are now recognized as one of the six largest advertising agencies in the United States.

The Abendroth & Root Manufacturing Company, 28 Cliff street, New York city, has, through its St. Louis office, secured an order from the Alexian Brothers for two Root improved water-tube boilers, 150-horse-power each, to be installed in the new hospital in Chicago. The company has also secured the Schwarzchild & Sulzberger order for water-tube boilers, in the face of a strong competition, for their packing plant in Kansas City. This order calls for 1,000 horse-power.

The American Engine Company, Bound Brook, N. J., have just secured the order for the entire engine equipment of the new station of the Scranton Illuminating, Heat and Power Company, to be built on the site of the old station recently destroyed by fire. The equipment will consist of six American-Ball engines, five of which will be compound and one simple. Direct-connected generators will be used on four of these engines, and the station will be modern in all its appointments.

The Electric Appliance Company, Chicago, have just prepared a supplement to the Bryant catalogue of electrical specialties showing a line of some of the best electric light specialties that have been brought out during the past year. The supplement is also supplied with a special trade discount sheet giving trade prices on the goods listed. The Bryant specialties have a great reputation, and anything new brought out by this company is always received with considerable interest. The Electric Appliance Company would be glad to send one of these catalogues with discount sheet to the trade on application.

The Metropolitan Electric Company, of Chicago, have taken the agency of the Reynolds's self-insulating bug cut-out, and have a stock of these on hand, from which they can make prompt shipments. This cut-out is a new one, which has some very desirable features. It consists of two pieces of porcelain so recessed and put together as to entirely cover and connect the fuse wire and connections. It is neat and compact in form, and the size is only about three-quarters of an inch in diameter by one and one-half inch long. This, with the other desirable features, makes it a cut-out which will fill many requirements of the wiring trade.

Water-Wheel Governors for the Minneapolis Plant—The Lombard Water Wheel Governor Company, of Boston, have closed a contract with the St. Anthony Falls Water Power Company, of Minneapolis, to furnish them seven governors for the new plant which they are now building. These seven governors are to regulate four water-wheels each, or 28 water-wheels in all, having an aggregate capacity of 10,000 horse-power. The style of governor to be employed in this plant is designated by the manufacturers as Type C. During the past year the Lombard company have, with this type of governor, regulated over 40,000 horse-power of water-wheels in the United States. On account of the magnitude of this plant the question of governors was very carefully looked into before the above order was placed.

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Electrical Manufacturers, Attention!

Messrs. Toomer, Nunn & Co., Calle de Gante 8, Mexico City, Mexico, are contractors for all classes of electrical work, and for building electric light plants, telephone and telegraph lines, etc., throughout the Mexican Republic.
They desire the names of manufacturers of electrical apparatus and supplies in the United States.
Reference: Bank of London and Mexico, Mexico City.
This company purposes doing a large business in the electrical line, and will carry a large stock of electrical material to supply the trade.
Manufacturers interested should write promptly to the above address.

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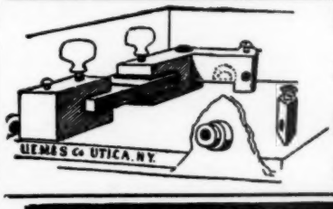
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[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

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577,427 Alternating-current motor; Ludwig Gutman, Pittsburgh, Pa.—Consists of the combination of a field magnet core, one or more windings for the same, an armature core, a winding or windings for said armature core, contact terminals connected to said winding or windings, and a block or brush permanently in contact with one armature terminal and temporarily with the other or others.

577,447 Automatic Circuit-Breaker; G. F. Packard, Fort Wayne, Ind.

577,450 Electric Railway System; C. F. de Redon, New York, N. Y.—A circuit-closer comprising a permanent magnet, a lever on which the magnet is mounted, a closed casing, in which the lever is pivoted, a contact plate on the lever, contact blocks for engagement with the plate, and a retarding device for the closer.

577,493 Electric furnace; F. J. Patten, New York, N. Y.—A central carbon electrode, an inner lining or wall of carbon, and carbon pencils of relatively small diameter, extending from one to the other, and means for passing an electric current through the pencils singly or in groups.

577,499 Filament for electric lamps; J. H. Douglas-Willan, London, Eng.—The process for treating filaments, consisting in rendering them incandescent in the presence of a compound containing boron, carbon and oxygen.

577,501 Electrically operated ship's log; W. S. Alexander, New York, N. Y.—A recording device controlled electrically in combination with a rotator in electrical connection therewith, the rotator having an axial shaft, with circuit controller mounted thereon, controlling said circuit to the recorder; a hollow shell filled with oil or its equivalent, suitably mounted to revolve on the axial shaft and provided with helical blades, and a lug to trip the circuit controller.

577,526 Electro-pneumatic brake; F. Chapel, Paris, France—Consists of an electrically operated brake valve for a pneumatic brake system, comprising an oscillating electro-magnet, a single line wire leading thereto, means for sending reversed currents over said wire, and valves operated by the oscillation of said magnet.

577,532 Annunciator; A. R. Miranda, Boston, Mass.

577,534 Submarine telegraphy; A. Muirhead, London, Eng.—Consists of perforated ribbon-actuating devices and lever contact devices adapted to respectively enter perforations in the traveling ribbon, and by their movement thus adapted to established battery contacts, and a rotating cam, acting after a determined interval of time to restore the contact lever devices to their normal position.

577,540 Telegraph transmitter; H. A. Taylor, London, Eng.

577,550 Electric and gravity pleasure railway; J. A. Griffiths, Philadelphia, Pa.

577,635 Electric signal for highway crossings; W. W. Alexander and M. C. Gillham, Kansas City, Mo.

577,670 Apparatus for producing electrical currents of high frequency; Nikola Tesla, New York, N. Y.—A source of electric energy, a plurality of condensers and a discharge circuit therefor, a motive device and a circuit controller operated thereby and adapted to direct the energy of the source into the condensers and connect them with a discharge circuit successively and in alternation.

577,671 Manufacture of electrical condensers, coils, etc.; Nikola Tesla, New York, N. Y.

577,678 Voltmeter; Paul Brant, Berlin, Germany—A core or armature for solenoids, comprising a soft iron sleeve and a bundle or cluster of wires contained therein.

577,704 Electrical insulator; Tapley W. Young, Washington, D. C.—A conductor of electricity in combination with an electric heater, arranged in proximity to a support of a conductor and a hood for shedding water away from the electric heater.

577,741 Trolley for electric railways; H. N. Gale, Bristol, Ct.—A trolley pole, forks borne by the trolley pole, having ways for the trolley-wheel shaft, the trolley-wheel shaft hung in said ways, and the trolley wheel rotarily hung on said shaft.

577,742 Electric Transformer; Ludwig Gutman, Peoria, Ill.—Two U-shaped pieces of magnetic material, whose butting joints form the letter Z.

577,760 Electric arc lamps; George M. Lane, Asbury, Park, N. J.

577,771 Secondary battery; Henry G. Morris, Philadelphia, Pa.

577,802 Process of and apparatus for treating of arsenic ores; G. M. Westman, New York, N. Y.

577,822 Electric cut-out; James F. McElroy, Albany, N. Y.—Consists of a porcelain block, a curved grove channel-way therein, a curved fuse-wire placed in said channel-way, suitably connected, with a flexible covering over said channel.

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